AIRCRAFT ROCKETS

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SAFETY PRECAUTIONS

General Precautions

1. The Bureau of Naval Weapons shall be informed of any circumstances which conflict with safety precautions or which, for any reason, require changes in or additions to them.

2. When in doubt as to the exact meaning of a safety precaution, an interpretation shall be requested from the Bureau of Naval Weapons.

3. Do not make changes in or additions to rocket ammunition, components, or accessories without explicit authority from the Bureau of Naval Weapons. Authorized assemblies are shown in OP 1415.

4. No ammunition or explosive assembly shall be used in any rocket launcher for which it is not designated.

5. No ammunition other than dummy-drill shall be used for drill.

6. Particular caution shall be exercised during handling of rocket motors or assembled rockets to avoid propellent grain damage or fracture. Cracks or breaks in the grain increase the carefully calculated burning area and cause excessive internal pressure buildup, which may result in erratic motor performance.

Precautions for Setback-and-Air-Travel-Arming, Impact-Firing Nose Fuzes

1. If the fuze is armed, whether assembled in the rocket head or not, no attempt should be made to unarm it. If the fuze is armed, turning the propeller counterclockwise, as viewed from the nose, will cause the firing pin to pierce the detonator and set off the explosive train.

2. The fuze is safe as long as the cap assembly is held in place by the safety wire or the arming wire. If the cap assembly comes off by accident, the fuze is still safe as long as the propeller is engaged by the propeller locking pin. This can be determined by visual inspection. The fuze shall be considered armed if the propeller is out of engagement with the propeller locking pin and is free to rotate.

3. Armed fuzes must not be fired from rocket launchers.

4. If the fuze in an assembled round is armed inadvertently, the propeller should be carefully taped to prevent further rotation. The fuze then should be carefully unscrewed from the rocket, taking care not to drop the fuzed round or the fuze on its nose, or strike the fuze in any way. If possible this work should be done by explosive ordnance disposal personnel. If none is available, disposal should be as instructed by the officer in charge.

Precautions for Pressure-Arming, Impact-Firing Base Fuzes

If, for any reason, it is thought that the fuze may be armed, it should be treated as a hazardous item and disposed of accordingly. No attempt should be made to remove the fuze from the warhead.

Safety Precautions for Acceleration-Arming, Point-Detonating Nose Fuzes

1. Acceleration-arming, point-detonating nose fuzes which are damaged should be considered hazardous items and disposed of accordingly.

2. Fuzes found corroded should be returned to an ammunition depot in the rocket warhead in which they are issued.

3. Removal of fuzes from their warheads is not permitted except at ammunition depots unless there is specific authorization.

4. Fuzes in rockets which have been fired are armed. Since all the arming mechanism is inside the fuze, there is no method of determining visually whether the fuze is armed or unarmed.

Precautions for Deceleration-Discriminating Base Fuzes

If an extremely light impact has occurred after the forces of gas pressure, spring, and creep have had their effect, the fuze may be fired by an additional slight jar. A fuze which remains unfired after heavy impact also is very sensitive, since it may be expected that the firing pin has struck the detonator, and subsequent friction between

the firing pin and detonator may fire the fuze. In any event, the fuze or fuzed round should be considered hazardous and disposed of accordingly.

Precautions in Assembling Complete Rounds

Do not assemble or fuze rockets until just before the plane is ready to be armed. If this is not practicable, assemble them as near to this time as is feasible.

Do not assemble a high-explosive loaded rocket warhead to a motor without first making sure that the base fuze hole has a base fuze installed and gas-checked, or a base fuze hole plug installed and gas-checked, as in the case of AP/ASW Warhead Mk 29.

Precautions for Aircraft Rocket Launcher Packages

Safety precautions for Aero 6A, 7D, and 10D aircraft rocket launchers are covered in chapter 7.

Precautions During Assembly

1. Do not remove the fuze safety wires or clip.
2. Do not remove the shorting clip from the electrical connector.
3. Do not stand the assembled round on either end.
4. Protect the fins from damage during and after assembly.

Precautions During Disassembly

1. It is important that the fuze wrench designed for use with any particular fuze be used to remove the fuze from the round. Use of an improper wrench may engage the wrong holes, flats, or slots, and result in arming the fuze.
2. If a fuze adapter becomes loose while removing the fuze, stop the operation. This is a defective round and is not to be repaired aboard ship. If grains of explosive are lodged between the adapter threads and warhead threads, unscrewing of the adapter may pinch and initiate the explosive.
3. Do not remove base fuzes, base plates, or nose fuze adapters from rocket warheads at any time.
4. No disassembly of rocket motor components as shipped is authorized. Under no circumstances is the rocket motor propellent grain to be removed from the motor tube.
5. Fuzes or firing mechanisms for rockets shall not be removed (except nose fuzes), disassembled, repaired, or in any way altered except as provided by special instructions from the Bureau of Naval Weapons.
6. Upon removal of components from the round, inspection of those parts of the components which could not be inspected when the round was assembled must be made before the components can be returned to stowage.

Precautions in Handling

1. Handle all components as little as possible.
2. Instruct personnel who will be involved in the handling as to the nature of the material. Only those men essential for handling should be in the area.
3. Personnel working with chemical rockets should have at hand protective gear. When entering concentrated smoke clouds produced by smoke rockets, men should wear gas masks.
4. No disassembly of basic rocket components is authorized except under instructions from the Bureau of Naval Weapons. This applies to warheads, motors, and fuzes.
5. Do not use a circuit continuity tester to check the igniter circuit in a motor aboard ship. The circuit is checked before the motor is placed on board.
6. If dropped from a height exceeding 5 feet, a fuzed rocket warhead (whether or not in a container) shall be returned to an ammunition depot. If return to a depot is not practicable, dispose of the warhead.

Stowage Precautions

1. Rocket motors are stowed separately from rocket warheads where possible. The motor is not propulsive unless joined to the warhead.
2. Rocket warheads for which fuzes are issued separately shall not be stowed with

those fuzes installed in or near magazines containing explosives.

3. Electrically fired rocket motors, and electric or electronic fuzes shall not be stowed in the same compartment with, or be exposed within 5 feet of, any exposed electronic transmitting apparatus or exposed antenna leads.

4. Matches, naked lights, or any open flame is forbidden in the vicinity of rocket stowage.

5. Rockets containing pyrotechnic material, such as flare or an incendiary mixture, shall be stowed in regular pyrotechnic stowage spaces, if such are provided, or in pyrotechnic lockers on upper decks.

6. Nothing shall be stowed in rocket ammunition magazines except rocket ammunition, its containers, and authorized magazine equipment. No oily rags, waste, or material susceptible to spontaneous combustion shall be stowed in these spaces.

7. Remove all rocket explosive components from a magazine before work which might cause an abnormally high temperature or an intense local heat is undertaken.

8. Ready-service stowage of assembled rockets is not authorized.

9. Rockets should be kept in the shade, away from direct sunlight, to avoid raising their propellant temperature above the prescribed safe limit.

Precautions During Inspection

Do not attempt in any manner to clean a fuze cavity which does not have a cavity liner.

Precautions for Disposal of Misfires

1. A 10-minute interval is to elapse between the last attempt at firing the round and any attempt to remove the round from the launcher. The plane should be pointed in the safest direction possible.

2. Do not test the launcher firing circuit until all rockets have been removed from the plane.

Precautions for Using Circuit Continuity Testers

1. A rocket circuit continuity tester should not be issued or used aboard ships without specific permission from the Bureau of Naval Weapons.

2. Dry cells should be changed by authorized personnel only. Any damage to the test set might cause abnormal currents to be delivered to the igniter circuit.

Precautions for Handling Circuit Continuity Testers

1. Keep the test switch in the OFF position at all times when the instrument is not in use. Failure to do so will cause the battery to run down.

2. Equipment containing batteries or other sources of electricity must NEVER be tested with this circuit continuity tester. The meter or Wheatstone bridge circuit can be burned out.

3. When the instrument is returned to its carrying case, the meter end should always be toward the bottom of the case.

4. Keep the test set and carrying case dry.

Frontispiece. FJ–4B Fury with Aero 7D Aircraft Rocket Launcher Packages Installed.

Chapter 1

GENERAL INFORMATION

This publication is intended for use by trained personnel who are authorized to handle Navy rockets designed for firing from aircraft. It provides them with specific information including description, identification, assembly, and use of aircraft rockets.

Principles of Rocket Propulsion

Rockets are propelled by the rearward expulsion of expanding gases from the nozzle of the motor. It is a common misconception that rockets are pushed forward by the action of the hot gases on the surrounding air, but rockets can function even in a vacuum.

To understand how a rocket operates, consider a closed tube into which a gas under pressure has been introduced. The pressure of the gas against all the interior surfaces is equal and the system is in equilibrium, figure 1–1(A). If the right end of the tube is removed, figure 1–1(B), the pressure against the left end is unopposed and the tube tends to move to the left.

In a rocket motor, sufficient confinement of the gases evolved in the burning of the propellant is necessary to permit a buildup of pressure to provide the sustaining driving force. This can be accomplished by restricting the size of the opening, as in figure 1–1(C). In this case, the useful thrust is the difference between that force acting on the remainder of the left end and that acting on the right end. However, with this type of design, considerable turbulence is caused in the flow of gas through the opening, with a consequent loss of available energy. This turbulence can be decreased greatly by adopting a design similar to figure 1–1(D). In this instance, the horizontal component of the force acting on the right wall is equal in magnitude to the force acting on the right wall in figure 1–1(C).

If a divergent expansion section is added, figure 1–1(E), advantage can be taken of the force of the expanding gases acting on the wall of the expansion section. This force adds to the useful thrust.

Aircraft Rocket Development

Rocket History to World War II. Although the history of rockets covers a span of eight centuries, their use in aircraft armament began in World War II. Rockets answered the need then for a large missile which could be fired without recoil from a plane.

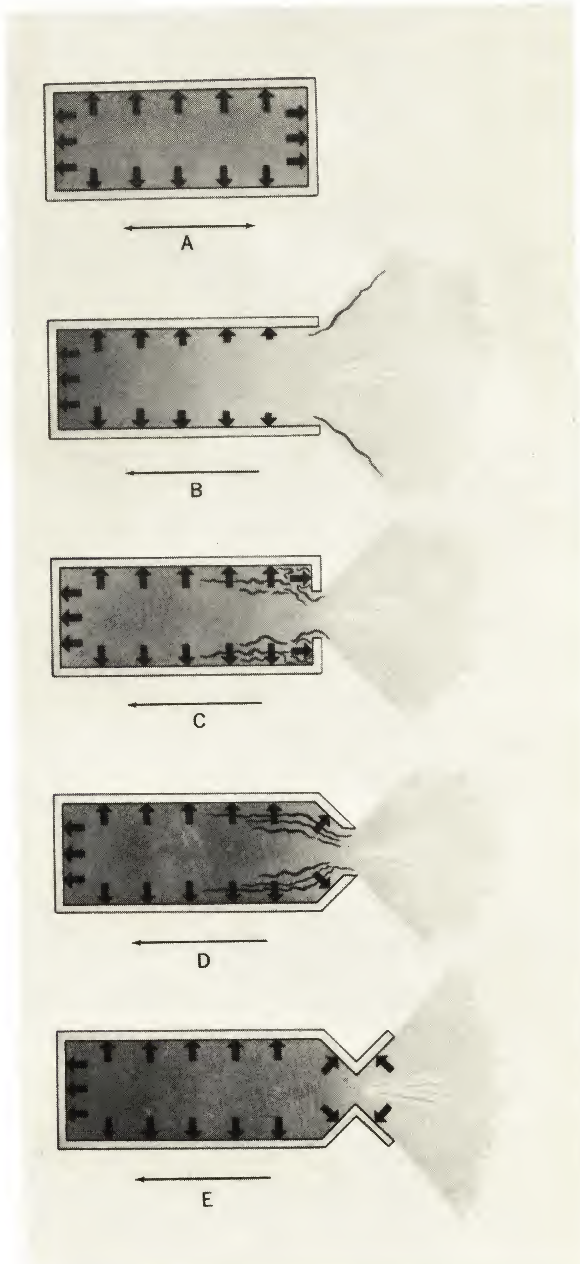


Figure 1–1. Principles of Rocket Propulsion.

The first Navy development was a rocket-propelled bomb, a weapon designed to increase the bomb's penetration of armor without increasing the altitude from which it was dropped. Despite their promise, armor-piercing bombs proved less valuable in practice than bombs which compensated for their lack of penetrative ability with a greater volume of explosive. Success with general-purpose bombs and new attack techniques made large-scale procurement of rocket-assisted bombs unjustified later in the war.

The Retrobomb. A subsequent Navy project was the development of the retrobomb, a missile fired backward from a plane at the same speed that the plane was traveling, so that the missile would fall straight to the target. This type of weapon was needed for use with the Magnetic Airborne Detector, a device for locating submarines.

The MAD is an instrument which indicates the presence of a submarine only when the plane is directly above the submarine. Ordinary bombing or depth charging is impracticable because the trajectory of either weapon follows the path of flight of the plane.

The usefulness of the retrobomb was shortlived because planes were forced to fly directly over the submarines at altitudes between 100 and 300 feet in order to make a hit. Learning this, submarine commanders surfaced and used their antiaircraft guns effectively against the planes before they could get within bombing range.

Later Developments in World War II. The early discarding of the rocket-propelled, armor-piercing bomb and the retrobomb did not discourage those who realized the advantages of rockets as aircraft weapons. The speed of planes lent to fin-stabilized rockets an initial velocity that produced stability and accuracy not possible from shipborne launchers. The size of rockets promised a destructive power far beyond the aircraft's machine guns.

A rocket employing a 3.5-inch solid warhead and a 3.25-inch motor was designed for launching from rails under the wings of torpedo bombers. Purpose of the solid warhead was to rupture the hull of a submarine.

A 5-inch warhead with a larger payload of high explosive and an air-arming fuze was designed for the same 3.25-inch motor. The assembly, however, was unsatisfactory in accuracy and range. A new design, employing the same 5-inch warhead plus a 5-inch motor, was developed. It was known as "HVAR", high-velocity aircraft rocket. It was put into combat use successfully in August 1944.

The need for a simple, economical rocket for practice firing resulted in the 2.25-inch SCAR, subcaliber aircraft rocket.

Meanwhile, work was in progress to develop the largest practicable rocket which carrierbased aircraft would be capable of carrying. This project produced the "TINY TIM," a rocket comprising a 500-pound semi-armor-piercing bomb, measuring 11.75 inches in diameter, and an 11.75-inch motor. The rocket was launched from a slightly modified bomb rack. It was first used in action in March 1945. It had the effect of a 12-inch projectile, being capable of penetrating 4 feet of concrete.

Rocket development during World War II did not follow a normal plan. Time was not available for detailed study of the whole complex of rockets: their components, materials, launchers, and personnel factors. There were not enough of certain materials to produce the best designs.

A case in point is the 11.75-inch rocket. The 11.75-inch pipe for the motor tube was chosen because the material was not on the critical list and also because this size of pipe coincided with the outside diameter of a 500-pound bomb, which could be used as the rocket warhead. The aircraft rocket program in World War II can be said to have ended with TINY TIM.

Postwar Developments. The major postwar aircraft rocket development has been the 2.75-inch folding-fin rocket called the "MIGHTY MOUSE, and the 5-inch ZUNI." These rockets have fins that are hinged in

order to maintain the nominal caliber diameter when the rocket is in the launcher.

Use of folding fins increases the number of rounds carried in a given space and the number which may be fired from a given frontal area. The 2.75-inch rocket may be fired from single launchers or from a multiple "package" launcher. For air-to-air firing, the fuze will function only on a direct hit. One of the available fuzes, Mk 176, incorporates a delay element which allows time for the warhead to penetrate the outer skin and to detonate inside an aircraft. Other types of fuzes, Mk 178, are designed for instantaneous action on impact. Although originally intended for air-to-air use, the 2.75-inch folding-fin rocket also has proved to be a potent air-to-ground weapon against a wide variety of targets. Another more recent folding-fin, general-purpose aircraft rocket is the 5.0-inch ZUNI which has greater striking power and a larger variety of warheads than the 2.75-inch FFAR. The motors of both rockets are relatively insensitive to temperature and are capable of operating beyond the temperature tolerances assigned many aircraft rockets.

Rocket development today is carried out principally at the Naval Ordnance Test Station at China Lake, California, although other naval activities contribute to rocket design and testing.

Comparison of Rockets with Gun Ammunition

In this comparison, rockets possess certain definite advantages and equally definite disadvantages. They have the advantage of being relatively simple and economical. They have no recoil force, which permits their use on aircraft without heavy, complicated launching apparatus. They possess a larger missile capacity with comparatively less weight of missile and launcher combined.

One disadvantage is that some rockets must be fired over a narrow range of temperature. Another disadvantage is their relative inaccuracy compared to guns. The mean dispersion for aircraft rockets is of the order of 10 to 20 mils; for guns it is of the order of 1 mil or less.

Comparison of Rockets with Bombs

Rockets have the advantage of propulsion, which allows their use against air targets as well as surface targets, particularly certain surface targets which cannot be attacked readily with bombs. Their propulsion gives them greater power for penetration of armor. The disadvantage of rockets compared to bombs is that they carry less payload in relation to weight.

Comparison of Rockets with Guided Missiles

Many current guided missiles are basically rockets, since they are rocket propelled. Guided missiles are a separate classification because they have systems which continually control their flight; however, some guided missiles may be countermeasured, rockets cannot.

Rocket Terminology

Common Terms. The following are terms which are not defined elsewhere in this publication. They are illustrated in the appropriate chapters.

1. AMMUNITION—all the components, and any and all explosives in any case or contrivance prepared to form a charge, complete round, or cartridge for cannon or small arms, or for any other weapon, torpedo warhead, mine, bomb, depth charge, demolition charge, fuze, detonator, projectile, rocket, or the like; all signaling and illuminating pyrotechnic materials; and all chemical warfare materials under the cognizance of the Bureau of Naval Weapons or used by the military services for offensive, defensive, saluting, and training purposes.

2. AMMUNITION COMPONENTS—integral units which are parts of a complete round of ammunition. Ammunition components may consist of inert parts, explosive parts, or both. Examples of ammunition components are fuzes, rocket warheads, rocket motors, rocket fins and fin assemblies, dummy nose fuzes, auxiliary boosters, igniters, and propellent grains.

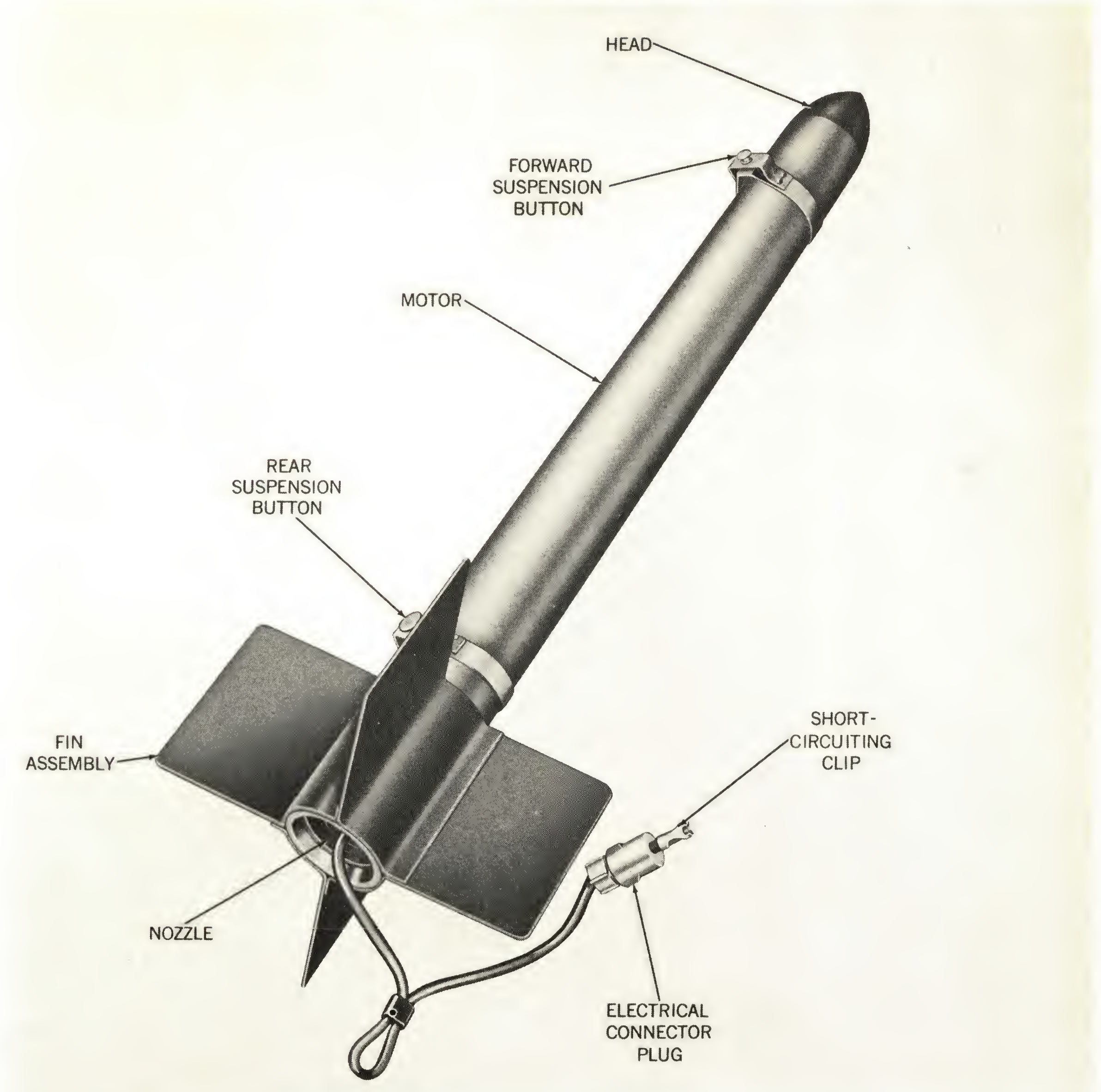


Figure 1–2. Simple Aircraft Rocket.

3. AMMUNITION DETAILS—accessories used in packing, handling, protecting, and surveillance of ammunition; for example: containers, thread protectors, spacers, and fuze covers.

4. BOOSTER—an assembly containing an intermediate explosive, which is sensitive enough to be detonated by a small amount of initiating explosive and is powerful enough to cause detonation of a less sensitive explosive.

5. DELAY ELEMENT—an assembly containing a relatively slow-burning explosive initiated by a primer, which delays the functioning of the succeeding units of the explosive train. Black powder is commonly used in delay elements.

6. DETONATOR—an assembly in the explosive train of fuzes which contains a charge of high brisance. When fired by the primer or delay element, the detonator explodes with sufficient force to initiate a booster. Tetryl and the metal azides are common detonator charges.

7. EXPLOSIVE—a chemical compound or mixture of substances which, when subjected to suitable initiating impulses or agents such as flame, spark, heat, impact, or friction, whether applied mechanically or electrically, will undergo chemical and physical transformation at speeds varying from extremely rapid to near-instantaneous. This transformation will create a more stable compound, resulting in a considerable and rapid rise in pressure caused either by the generation of a much larger volume of gas than originally present or by the evolution of large quantities of heat, without gas, and other forms of energy with consequent expansion of the surroundings or both. The transformation accomplishes work of either useful or destructive character, depending on the measures of control exercised over the reaction. A list of common rocket high explosives follows.

a. Composition B—a mixture of RDX, TNT, and wax. It is used as the main charge of some rocket warheads.

b. Explosive D—a relatively insensitive explosive used as a main charge chiefly in armor-piercing rocket warheads because of its ability to withstand severe shock.

c. Fulminate of mercury—a highly sensitive explosive used in fuze primers or detonators.

d. HBX—a relatively insensitive explosive that is chemically stable and noncorrosive. It is in the same general class as TNT with respect to relative safety of handling. HBX–1, which is used in some rocket warheads, is a variation developed to provide even greater stability and power.

e. Lead azide—a highly sensitive explosive used in primers and detonators.

f. Tetryl—a sensitive explosive used in boosters and detonators.

g. TNT—a general-purpose explosive used in cast form as a main charge in some rocket warheads not designed to pierce heavy armor. TNT is sensitive to high-order shock.

8. EXPLOSIVE TRAIN—a functional arrangement of different types of explosives in a fuze which initiates the main charge of the rocket warhead. Depending on the fuze, it may consist of a primer, delay element, detonator, and booster. Each separate component is less sensitive than the preceding charge, starting with the primer and working to the booster.

9. FINS OR FIN ASSEMBLY—a flight stabilization device, usually a number of tail planes, which tend to keep the rocket on its aimed trajectory.

10. FUZE—the initiating device which detonates a high-explosive main charge; or expels, disperses, or fires some other type of load.

11. HANGFIRE—a misfire which later fires from delayed ignition.

12. WARHEAD—that part of the rocket containing the payload; either high explosive, chemical, or special filler, and the fuze. The payload may be solid metal, with no fuze.

13. HIGH VELOCITY—a phrase used to describe 5.0-inch rockets used with 5.0-inch warheads and motors, to distinguish them from 5.0-inch rocket assemblies employing motors of smaller diameter.

14. IGNITER—the initiating device which ignites the propellent grain. It usually is an assembly consisting of an electric squib, match composition, black powder, and magnesium powder.

15. MAIN CHARGE—the high-explosive filler of the rocket warhead.

16. MISFIRE—a situation in which a rocket does not fire when the firing circuit is energized.

17. MOTOR—the propulsive component of a rocket. It contains the propellant, the igniter, and the nozzle(s).

18. PRIMER—the first element in the explosive train of a fuze. It is a sensitive explosive which usually is initiated by a

firing pin and, in turn, initiates the next element, which is less sensitive, in the explosive train.

19. PROPELLENT GRAIN—the solid fuel used in a rocket motor which, upon burning, generates a volume of hot gases that stream from the nozzle and propel the rocket. Also called propellant or propellent powder grain.

20. RETRO-FIRED—fired in a direction opposite to the aircraft's direction of flight, usually to make the rocket drop in a straight line to the target.

21. ROCKET—a missile propelled by the sustained reaction of a discharging jet of gas against the container of the gas.

22. ROUND—an assembly of all the components necessary for functioning of the rocket for the purpose intended. This includes warhead, motor, and fuze(s).

23. SUBCALIBER—a term referring to a practical round of less than the caliber of the service round. Although smaller than service rounds, subcaliber rockets have the same characteristics of trajectory.

24. THRUST—the force exerted by the rocket motor.

Abbreviations

ADF or Aux Det	auxiliary detonating fuze
AP	armor piercing
ASW	antisubmarine weapon
A/T, AT	antitank
BDF	base detonating fuze
CAL	caliber
CHG	charge
CTN	carton
CT-TNT	cast TNT
CWR-N	chemical warfare rocket-Navy
DNF	dummy nose fuze
DNP	dummy nose plug
DWG	drawing
EX, X	experimental
EXP	expellant or explosive
Exp "D"	Explosive "D"
FCL	fuze cavity liner
FF	folding fin
FFAR	folding-fin aircraft rocket
F	fuze
FRAG	fragmentation
FS	fin stabilized
FSL	fuze seat liner
GP	general purpose
HC	high capacity (no longer used)
HE	high explosive
HEAT	high explosive antitank (shaped charge)
HVAR	high-velocity aircraft rocket
IGN	ignition
INST	instantaneous (also "Instruction" when applicable, such as "NAVORDINST")
MFR	manufacturer
Mk	mark
MM	millimeter
Mod	modification. (The term "mod" is now commonly used as a noun or adjective and is no longer considered strictly an abbreviation.)
N	Navy
NAD	Naval Ammunition Depot
NAS	Naval Air Station
NAVORDINST	Naval Ordnance Instruction
NF	nose fuze
NM	naval magazine
NOP	Naval Ordnance Plant
NOTS	Naval Ordnance Test Station
OBS	obsolete
OD	ordnance data
OP	ordnance pamphlet
OS	ordnance specification
PDF	point detonating fuze
PDR	powder
PRAC	practice
PWP	white phosphorus, plasticized
PWPV	white phosphorus, plasticized, vulcanized
RKT	rocket
Rd	round
RETRO	fired in a direction oppo-

	site to the plane's direction of flight
RH	rocket head
RM	rocket motor
RTP	requirements and test procedures
SC	subcaliber
SCAR	subcaliber aircraft rocket
SER	service
VT	radio proximity; i.e., a fuze activated by its proximity to the target. It is also called "variable time fuze" and "influence fuze" (VT is a code symbol, not strictly an abbreviation.)
WP	white phosphorus

Classification of Rockets

Rockets may be classified as either spin-stabilized or fin-stabilized. At present, all aircraft rockets are fin-stabilized. Some have folding fins; others have fixed fins.

Rockets may be classified further as to their purpose; i.e., service, practice, or dummy. Service rockets have live-loaded motors and warheads which carry a payload of high explosive, a chemical, or a special device. Service warheads are used in combat. Practice rockets have live-loaded motors and either solid heads or heads with an inert load, usually of plaster. They are used for target practice. Dummy, or dummy-drill rockets have an inert-loaded motor and a practice head. They are used for training in handling, and for testing launchers.

Subcaliber rockets have live-loaded motors and practice heads. They are made smaller than the service rockets which they simulate for economy in practice firing. Practice and subcaliber rockets have approximately the same velocity and trajectory as the service rockets which they simulate.

Rocket Heads

Several types of heads have been developed to meet different tactical requirements. Specific heads are treated by mark and mod in chapter 2. Figure 1–3 illustrates the general types. Their nomenclature and description follow.

Armor-Piercing (AP). This type is designed to penetrate armor plate or fortifications before it is exploded. Usually made of heat-treated steel, an armor-piercing warhead has thick walls and, consequently, a smaller explosive charge than other warheads.

The explosive used is one which will withstand the shock of impact without detonating. Explosive D is the charge normally employed. Since the nose section of an armor-piercing warhead must be of maximum strength, the fuze is located in the base.

General Purpose (GP). This type is a compromise between the armor-piercing and the high-explosive designs. The general-purpose warhead has a nose section and walls not as strong as those of an armor-piercing warhead, yet stronger than those of a high-explosive warhead. The explosive charge is more than that in the armor-piercing warhead, but less than that in the high-explosive warhead.

The general-purpose warhead is for use against a variety of targets. Its maximum penetration may be obtained by using a solid nose plug and a delayed-action base fuze. Its maximum blast effect may be obtained by using an instantaneous-action nose fuze.

High Explosive (HE). This warhead is designed to damage a target by the blast of its explosive charge or by the fragments from its shell. The warhead has a relatively high percentage of explosive by weight. Because of the thinness of its walls, it will penetrate only light armor.

It is fuzed in the nose, since it is ordinarily intended for instantaneous action. However, it may be assembled with a delayed-action base fuze to allow some penetration of the target.

An auxiliary booster, figure 1–4, may be installed in an HE warhead to insure thorough detonation of the relatively large

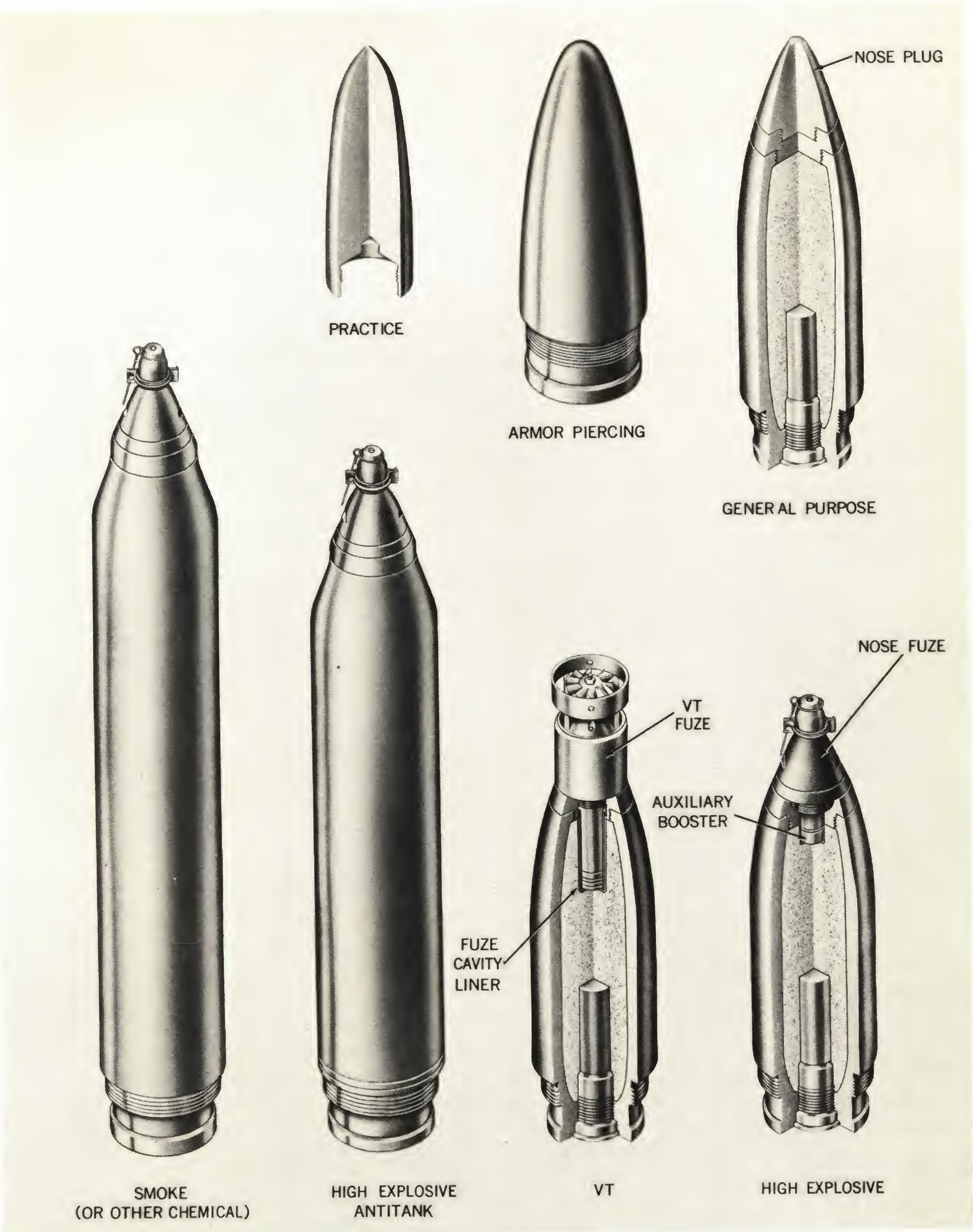


Figure 1–3. Types of Rocket Heads.

explosive filler. An auxiliary booster supplements the detonating capacity of the booster in the fuze. Granulated TNT normally is the explosive used in the auxiliary booster. The location of an auxiliary booster to supplement a nose fuze is shown in figure 1–3. Auxiliary boosters are shipped installed in the warhead.

Figure 1–4. Typical Auxiliary Booster.

High-Explosive Antitank (HEAT). This type was developed for use against tanks, but is equally effective against other armored or fortified targets. This warhead employs the shaped-charge principle of explosives to produce a jet of high-velocity, high-temperature particles which will force its way through an extraordinary thickness of armor.

The explosive jet will penetrate heavy armor metal or concrete, but will not produce an explosive blast behind the armor. The jet will materially increase the temperature behind the armor and, in the case of a small enclosure such as the inside of a tank, its searing heat normally will kill the occupants.

Recent development of improving the fragmentation of this round, for antitank as well as for antipersonnel use, will result in its redesignation to ATAP.

The explosive charge in this type of warhead is detonated at its after end to produce the jet from the cone at the forward end. Detonation by the booster in the after end usually is accomplished through transmittal of the explosive impulse by a length of detonating cord. It connects the booster charge to the initiating charge which is adjacent to the nose fuze. The combination of an instantaneous-acting nose fuze and rapid-burning detonating cord permits detonation of the explosive load in time for the shaped-charge to produce its explosive jet before being disintegrated by impact on the target.

Practice (PRAC). Practice heads are of two types, subcaliber heads and inert-loaded service heads. Most subcaliber heads are a hollow metal slug, although the hollow spaces may be filled with an inert material to bring the weight within required limits. One type of subcaliber head is solid metal. The inert-loaded service head is a service head in which the weight and placement of an inert filler give the head the same ballistic characteristics as those of the explosive-loaded service head, called warhead.

Smoke (SMOKE). This warhead is designed to produce a volume of heavy smoke for target identification or screening purposes. It employs a tube of explosive, usually tetryl, which bursts the relatively thin walls of the warhead, dispersing the smoke. This burster tube is activated by a nose fuze. The abbreviation (SMOKE) for this warhead is followed by the abbreviation for the smoke-producing agent which the warheads contain; for example, WP for white phosphorus or PWP for plasticized white phosphorus.

VT. This warhead was developed to receive a VT fuze. VT fuzes generally are larger than mechanical fuzes, requiring a larger space in the warhead. Essentially, a VT warhead is a high explosive warhead with a larger fuze cavity.

Head Details and Components. Rocket warheads are shipped with base fuzes installed; nose fuzes usually are shipped separately. Shipping plugs protect the threads for the fuze and for the motor usually, when auxiliary boosters are part of the rocket assembly, they are shipped installed in the warhead.

Larger rocket warheads have two spanner holes near the base, located 180° apart, to facilitate assembly of the warhead and motor. An adapter ring in some nose assemblies permits use of more than one thread size for fuze installation.

A metal or plastic cup may be secured in the nose or base portion of the explosive filler. This cup, which is a fuze cavity liner or fuze seat liner, allows installation or replacement of fuzes without contacting the surface of the explosive filler. If a cavity liner or seat liner is used as a "former," or a former plug is used, it eliminates the need for machining the cavity in the explosive filler during loading of the warhead.

Rocket Motors

The principal parts of rocket motors are described and illustrated, figure 1–5, in this section. Specific information on particular marks and mods is found in chapter 3.

Motor Tube. The tube usually is a steel or aluminum cylinder. One end is secured

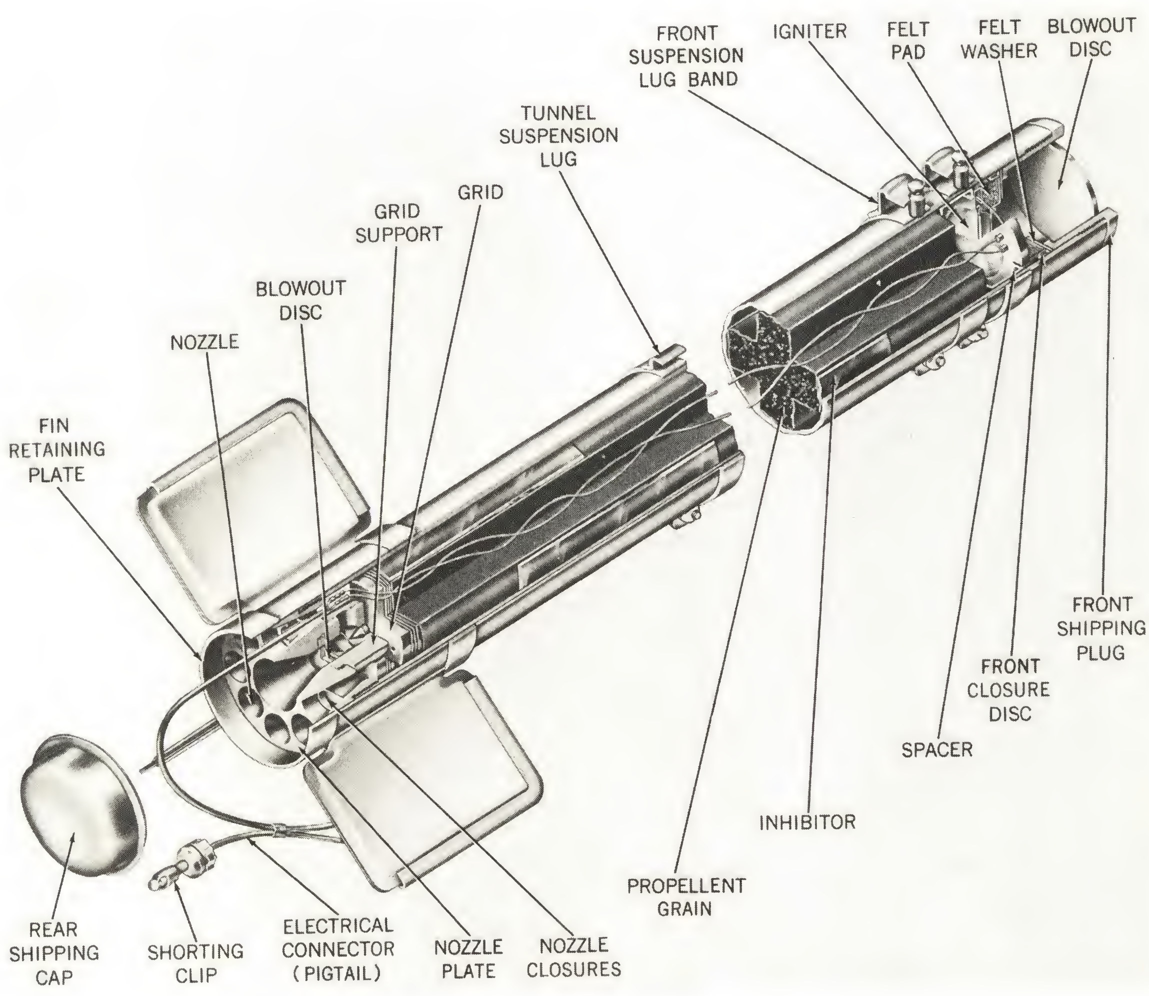


Figure 1–5. Typical Aircraft Rocket Motor, Sectional View.

to the rocket head by threads. The other end receives the nozzle assembly, which may be secured by threads, lockwire, or welds. The tube holds the motor components in place and provides a combustion chamber for the propellant.

Propellant. All rockets treated in this publication use a solid propellant. This propellant is similar in composition and function to gun ammunition propellent powder, but usually is in the form of a single long grain.

Rocket motors need a propellant that burns evenly and continuously. Gas pressure must be sufficient to propel the round and yet not so high that it bursts the relatively thin metal walls of the motor tube. To utilize the advantages of smokeless powder and, at the same time, meet these other requirements, a double-base smokeless powder, ballistite, is employed. Ballistite has the following approximate proportions:

	Percent
Nitrocellulose (gun cotton)	52
Nitroglycerine	43
Plasticizer (diethylphthalate)	3
Stabilizer (diphenylamine)	0.7
Flash depressant (potassium nitrate)	1.3
Opacifier (nigrosine dye)	0.1 added after ballistite is prepared

Propellent grains are shaped to permit the proper flow of gases to the nozzles and also to control the rate of burning. Grains are shaped to provide "neutral" burning, "progressive" burning, or "regressive" burning.

Neutral burning grains provide a relatively even thrust throughout the rocket flight that is particularly desired for air-to-air rockets. Such grains have a burning area that remains relatively constant until the propellant is almost consumed. Star-perforated grains, which are inhibited on the ends and exterior, can provide such even burning. Star-perforated grains may be cast for large rockets. Hollow cylindrical grains which are consumed from the exterior as well as the interior also are capable of providing neutral burning.

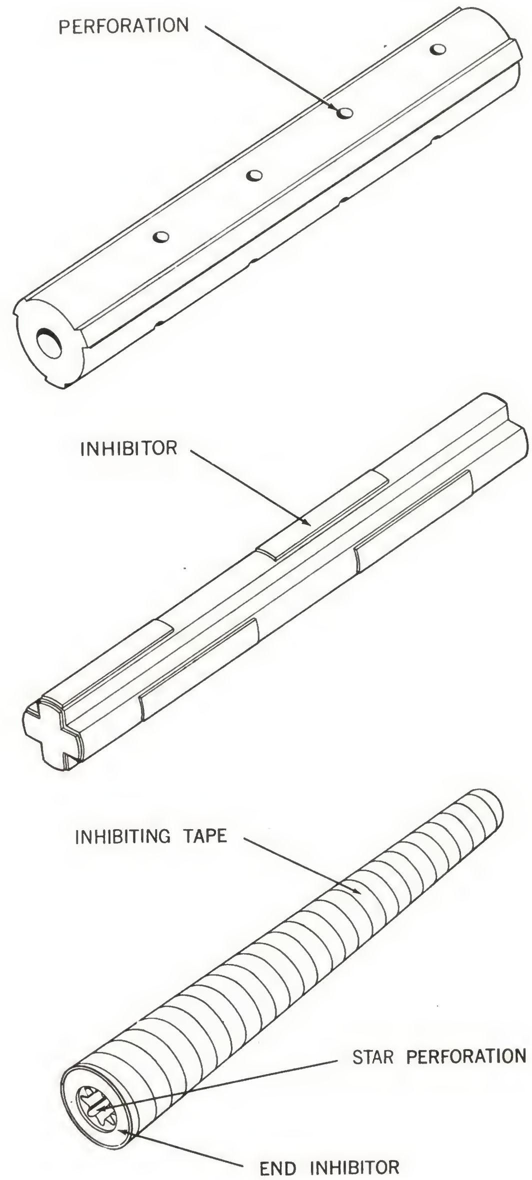


Figure 1–6. Typical Propellent Grains; Cylindrical Grains with Radial Perforations (top), Cruciform Grain with Inhibitor Strips (center), and Star-Perforated-Internal-Burning Grain (bottom).

Progressive burning grains provide a gradually increasing thrust that is desired for ground-to-air rockets. Such grains have a burning area that increases in size as the propellant is consumed. Cruciform grains, for example, if inhibited on the ends, will burn progressively.

Regressive burning provides a high initial thrust that gradually diminishes. It is desired in certain air-to-ground rockets. It requires grains that present a large burning area at first, which decreases as the rocket continues in flight. Solid cylindrical grains can provide such burning characteristics. Multiple grains, which consist of a number of solid cruciform grains, are used in 11.75-inch rocket motors. Although these motors are obsolete for service use, they are useful for sled tests and for other problems where a large initial thrust is needed.

Inhibitors. These are lengths of fire-resistant material used to prevent combustion of the surface to which they are cemented. They may consist of short rectangular plastic strips such as those used on cruciform grains, or they may be long tapes such as those spirally wrapped around certain cylindrical grains.

Igniter. The igniter heats the propellent grain to ignition temperature. It is a thin, disc-shaped metal container which fits against the forward end of the propellent grain. The igniter contains black powder, magnesium, and an electric squib. The squib consists of a resistance wire filament (the bridge) encased in match composition. Lead wires extend from the squib through the rear wall of the igniter. The lead wires pass along the length of the propellent grain and through a nozzle to the wire connectors.

Igniters are designed to respond in a minimum time with a squib current of 1.0 ampere or more, although as small a current as 0.2 ampere will set off the match composition and black powder after a short delay. The nominal resistance of the squib is 1.0 ohm; therefore, ignoring any line resistance, application of 0.2 volt is sufficient to set off the charge. Application of 0.75 volt gives satisfactory performance. In practice, the line and contact resistances of the igniter require higher voltages.

> NOTE: HVAR and ZUNI igniters have two squibs; the data here is not true for these igniters.

To insure that the circuit to the igniter in a rocket motor has the proper resistance, for safety and for ignition, tests are made at ammunition depots. Testing of this circuit is not permitted on board ship because of the danger of accidental ignition of the motor. Test sets in current use and the procedure to be followed in using them are described in chapter 8.

Nozzles. Nozzles direct the gas jet and utilize the expansion of the gas in an exit cone to increase total thrust, about 30 percent more than a simple opening. They also restrict the escape of gas from the reaction chamber, thus maintaining the pressure within the motor tube at a value suitable for the continued burning of the propellant.

Nozzles are metal parts formed as illustrated, figure 1–5. Some single nozzles are threaded directly to the motor tube. Other nozzles are pressed, brazed, or staked to a nozzle plate which is secured to the metal tube.

Some nozzle assemblies, such as that in figure 1–5, employ a central, "extra" nozzle as a safety device. In this particular arrangement, a thin copper plate is blown out of the central nozzle if the pressure in the motor tube reaches a level which might rupture the tube. The copper plate at the rear is insulated from the heat of the burning propellant by asbestos. The plate will not blow out in normal firing and burning of the motor. If extreme pressure does blow out the plate, the central nozzle utilizes the escaping gas pressure to increase the thrust of the motor.

Grid. The grid is located at the rear of the cruciform propellent grain, in front of the nozzle assembly. The grid supports the grain structurally before and during burning. The grid is shaped to allow clearance

for the gases flowing toward the nozzle. Grids are not used with internally burning propellent grains, however. Instead, motor support is provided by charge support spacers. Obturating seals on the after end of the motor hold the grain in place and help control the flow of gases.

Felt Spacers. Depending on the motor, a felt spacer or combination of spacers is used aft of the front closure to locate, support, or cushion the propellent grain and igniter. Some motors do not require spacers in this location. Felt washers also may be used forward of the front closure as distance pieces between the head protector and the front closure.

Suspension Bands or Buttons. Some rocket motors have metal buttons or lugs which hold the round in the launcher. The buttons are welded or clamped to the motor tube. The rear button also may hold the electrical connector during shipping. The connector cable is partially wrapped around the button and secured by a washer and spring clip, or tape.

Closures. There is a closure for each end of the motor tube. The front closure, which is sealed to the motor tube, may be a simple metal cup, or a disc with reentrant side walls and a central blowout disc crimped to the larger disc. The front closure is used with the nozzle or nozzle plate to hold the igniter, propellent grain, grid, and other motor components in place. It also acts as a seal to prevent the entry of foreign matter.

This simple closure, or the central blowout disc in the other type of closure, is easily blown out if the motor becomes accidentally ignited when it is not assembled to the head. Propulsion of the motor thereby is prevented.

Rear closures may be cupped discs which are friction-fitted to the motor tube. Another type consists of cups which are sealed into the nozzles only. The nozzle closures may be an integral part of an electrical connector. The rear closure nozzle seals provide hermetic sealing, prevent entry of foreign matter, and also serve to bring the motor chamber up to pressure for proper ignition.

Fins and Fin Assemblies. Projecting fins may be welded or secured to circular bands in a fin assembly. The assembly is fitted on the rear of the motor tube. Fin assemblies may have split bands secured to the tube by bolts passing through one edge of the band and threaded through nuts welded to the other edge. Other fin assemblies are secured by rings which are fitted on the tube behind the fin assemblies.

Some fins are hinged in such a way that the fins are folded behind the nozzle closure prior to launching. They are forced into a projecting position after launching. This arrangement permits greater economy in the space needed for launchings; consequently, more rockets can be launched from a given space or the reduced space requirement can be applied to improving the design of the aircraft.

Electrical Connector. This is the component which conveys the electric current from the firing circuit of the launcher to the igniter in the rocket motor. The connector usually consists of a jack plug, which connects to a receptacle on the launcher, and a cable with two wires. The wires in the cable are joined to the igniter leads by solderless connectors. On the connector cable may be a nozzle closure. When the rocket is fired, this nozzle closure is blasted from the nozzle and the igniter leads are pulled from the connector cable wires.

Short-Circuiting Clip. This clip is placed on the terminal end of the plug of the electrical connector. It shorts the two wires in the cable to prevent accidental energizing of the igniter circuit. This shorting clip is removed just before the plug of the connector is inserted into the launcher receptacle.

Rocket Fuzes

Classification. Rocket fuzes are classified according to their location in the rocket warhead or type of action of the fuze. Fuzes classified according to location are either

nose fuzes or base fuzes. The following are fuzes classified as to type of action.

1. Impact-firing fuzes are those that function when the rocket strikes a target which offers sufficient resistance. These also may be called point detonating fuzes (PDF) or base detonating fuzes (BDF). These fuzes may be designed to fire either instantaneously or after a short delay that affords the rocket time to penetrate the target before the warhead explodes.

2. VT (proximity-firing) fuzes are those which incorporate a radio transmitter and receiver and, after being launched, send out signals and receive the same signals reflected by the target. If the strength of the reflected signal is sufficient, the receiver triggers an electronic firing switch which starts the detonation of the firing train. Because of their special nature, only the exterior characteristics and assembly instructions for current VT fuzes are given in this publication.

Disassembly. Breakdown of aircraft rocket fuzes is not permitted except at authorized activities.

Use of Lubricants and Preservatives. No lubricants or preservatives of any kind shall be used on any fuzes.

Moisture Damage. Sensitive explosive material loses its effectiveness if it absorbs moisture. Rocket fuzes require gaskets or other sealing methods to render them moistureproof. For shipping, fuzes are packaged in hermetically sealed, tear-strip containers. Special care should be taken to prevent damage from moisture to fuzes which have been installed in rockets.

Forces Used in Arming Rocket Fuzes

The forces which are utilized to arm rocket fuzes depend upon the characteristics of the rocket for which the fuze is designed.

Setback. Setback is the term applied when fuze parts react to acceleration of the rocket. It causes movable parts to move aft when the fuze as a whole moves forward. Slow accelerations, compared to gun ammunition, are characteristic of rockets. The acceleration depends greatly upon the initial temperature of the propellant; it is quite small at low temperatures. By making the parts operated by setback relatively massive and the retaining mechanisms relatively weak, small setback forces can be utilized effectively.

Acceleration. This term applies to fuzes which utilize a gear timing device in conjunction with the setback principle described. A simple setback-armed fuze is armed by initial acceleration; acceleration-armed fuzes are armed by prolonged acceleration, the length of which is determined by the integral timing mechanism of the fuze.

Air or Water Travel. The force exerted by the air or water stream passing the rocket may be used to arm nose fuzes by turning propeller vanes.

Gas Pressure from Burning Propellant. During the burning of the rocket motor propellant, pressure of the gases is exerted on the base of the rocket warhead and base fuze. This pressure is fairly constant during burning and is of the magnitude of several thousand psi. Entrance of the gas can be controlled to delay the arming of the fuze.

Creep. Creep is a continuous inertial force caused by deceleration which, in turn, is caused by surface drag on the rocket after the motor has burned out. Internal fuze parts tend to move toward the nose of the round. These forces may be controlled by anticreep springs, which prevent fuze initiation until the fuze strikes a target with sufficient impact to overcome the resistance of these springs.

Friction. Frictional forces which are a consequence of setback and creep are not high in rockets. Friction is not utilized to any extent at present in rocket fuze operation.

Impact Inertia. Inertia existing at the moment of impact is used in some rocket

fuzes to bring about a phase of arming. Fuzes using this force are identified as "deceleration-discriminating."

Explosives Used in Rocket Fuzes

The explosive train of a rocket fuze may consist of combinations of the following: primer, delay element, detonator, detonator lead-outs, booster lead-ins, booster, and auxiliary booster.

Primer. There are two classes of primers used which are initiated by firing pins—the stab-type and the percussion-type. The stab-type, figure 1–7, is initiated by the penetration of a sharp-pointed firing pin through the metal case into the primer mixture. Stab-type primers generally are used when maximum sensitivity is desired. The percussion-type, figure 1–11, is initiated by crushing the primer against an anvil with a round-pointed firing pin.

Primer mixtures are intended to produce flame, hot gases, and particles, as a result of being struck or otherwise mechanically disturbed. They generally are composed of a sensitive initiating substance, such as lead azide or mercury fulminate; an oxidizing agent, such as potassium chlorate; and a reducible substance, such as antimony sulfide. They also may contain a friction-creating material, such as fine carborundum crystals.

Delay Element. The delay element is a pellet of compressed black powder which is ignited by the primer. The delay time is varied by adjusting the composition of the black powder, the packing of the pellet, and the volume of powder through which burning must proceed. The detonator-delay assembly of the base fuze, figure 1–11, uses a black-powder delay element.

Detonator. The detonator is initiated by the firing pin, primer, or delay element. It is composed of a pure initiating explosive, usually lead azide, followed by a small amount of tetryl. These materials may be sealed separately in small containers or together in one container. Relay detonators may be employed to pick up the flash from another detonator or a primer at a relatively distant location. A simple detonator is illustrated in figure 1–7; a detonator with lead-outs is shown in figure 1–12.

Lead-out and Lead-in. The lead-out and lead-in usually are small pellets of tetryl, which reinforce the explosion of the detonator and transmit it to a booster. The base fuze illustrated in figure 1–12 has both lead-outs and lead-ins. The lead-out is initiated by the detonator and, in turn, fires the lead-in which initiates the booster.

Booster. The booster, figure 1–12, is a comparatively large tetryl pellet, loaded in a magazine as part of the fuze. It usually is initiated by a lead-in and, as the final element of the explosive components of a fuze, initiates the payload of the warhead.

Safety Features in Fuzes

In general, the safety requirements for rocket fuzes are similar to those for gun ammunition and bomb fuzes. They contain devices to prevent detonation from normal transportation, handling, assembly, loading, and launching of the rocket.

Design requirements usually call for a detonator-safe fuze. This means that the explosive train must be interrupted so that, if the detonator is prematurely initiated while the fuze is unarmed, the booster of the fuze and, hence, the explosive filler of the warhead will not be detonated. In some fuzes, this is accomplished by out-of-line locations for the detonator and the booster when the fuze is in an unarmed condition. In others, the flash from the primer is blocked. The arming of a fuze is mainly the aligning of the detonator and booster, or the opening of the flash path.

Fuze Operation

The marks and mods of rocket fuzes usually involve only minor changes in the design of a relatively few basic types. This section describes the operation and general characteristics of these prototypes. In chapter 4, specific fuzes, mark and mod, are treated. The specific mark and mod will be described

in the following paragraphs by reference to its prototype.

Typical Setback-and-Air-Travel-Arming, Impact-Firing Nose Fuze. Because of its basically rugged construction, this type of fuze, figure 1–7, will penetrate moderately thick steel plate or reinforced concrete without allowing break-up of the rocket warhead in a manner that would impair the warhead's effectiveness. A cap which fits over the nose of the fuze protects the propeller and keeps it free of ice.

The internal mechanism of this type of fuze is housed in a heavy, conical steel body. The body cavity is closed at the forward end by a nose plate which is crimped in place. There are two holes in the nose plate. The firing pin is threaded into the central hole; the propeller locking pin extends through the other hole. A propeller and a hub are riveted to the forward end of the firing pin.

The firing pin extends rearward through the propeller locking pellet, shutter locking pellet, firing pin guide, and into the shutter cavity. It helps to hold the spring-actuated shutter, containing the detonator, in the unarmed position. The propeller locking pellet and shutter locking pellet, which contain the propeller locking pin and shutter locking pin respectively, are both held forward by the setback spring. The rear of the setback spring rests against the firing pin guide. The sleeve, shutter assembly, and lead-in disc are secured by the booster magazine.

The fuze is waterproofed and is protected at the forward end against damage in han-

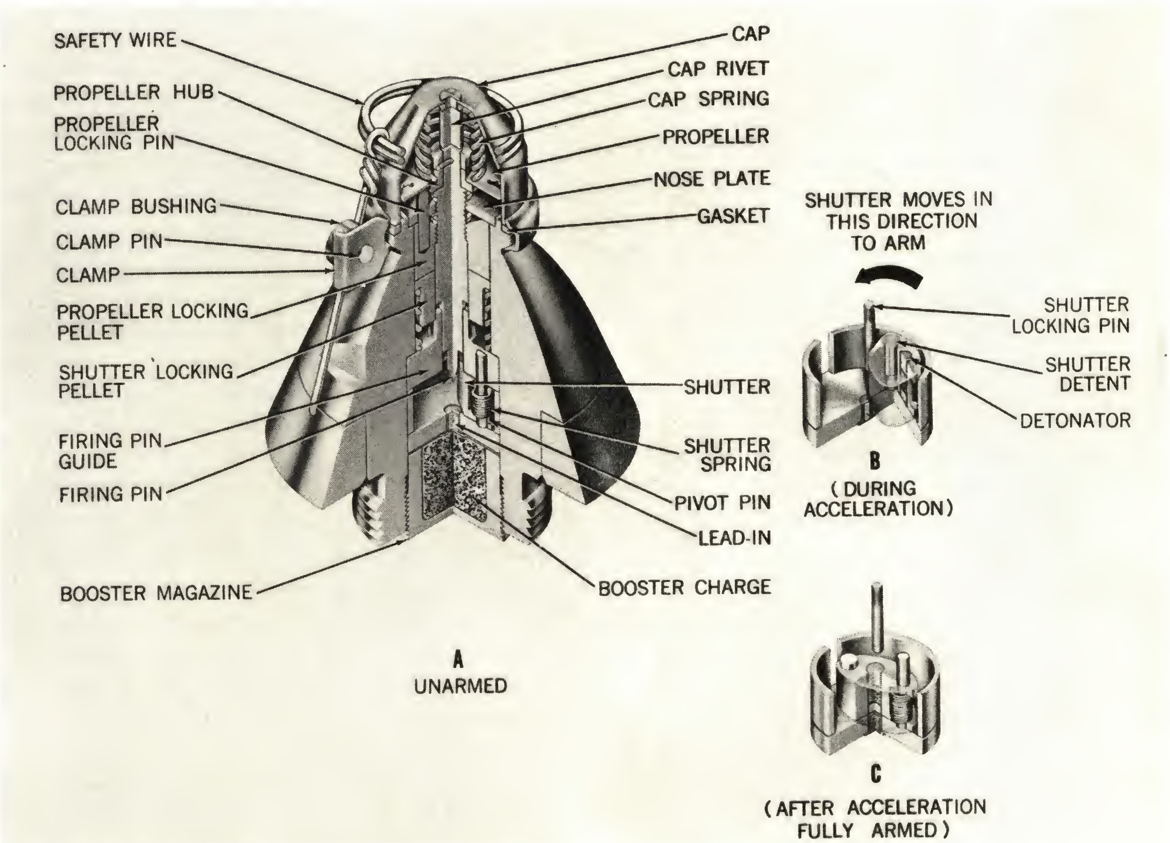


Figure 1–7. Typical Nose Fuze (Setback-and-Air-Travel-Arming, Impact-Firing), Sectional Views; (A) Unarmed, (B) during Acceleration, and (C) after Acceleration, (Fully Armed).

dling by the cap assembly. The cap assembly consists of a cap, a cap spring, and cap rivet. The open end of the cap is pressed against a fiber gasket (the outer gasket) and is held in place by a clamp. The cap spring pushes the cap assembly and clamp away from the propeller during arming. The cap rivet holds the spring in place and prevents the firing pin from turning to an armed position while the cap is clamped to the body.

The clamp is made of two half-circular steel strips hinged together. Each edge of each strip is formed to a channel shape that will pull the body and cap together as the clamp is closed and tightened. Each clamp arm, 180° away from the clamp hinge, is flanged away from the center of its half-circle. These flanges are drilled and held together by a clamp pin, a clamp bushing, and a safety wire.

The clamp pin is shaped somewhat like a flathead rivet, the head being too large to go through the drilled holes of the clamp flange. Its shank has two holes drilled to match two holes in the bushing. After the clamp pin is placed in the clamp flange holes, the bushing is placed over the shank of the pin, and the safety wire is inserted in the outer hole of the bushing and pin. After loading the complete round onto a plane, the arming wire on the plane is placed in the innermost hole of the bushing and the safety wire is removed.

When the rocket is fired, the arming wire is pulled from the clamp pin and bushing, allowing the clamp to open. The compressed cap spring then propels the cap and clamp away from the fuze.

The force of setback causes the two locking pellets to move aft, thereby unlocking the propeller hub and interposing a shutter lock by means of the shutter locking pin. The firing pin is withdrawn from the shutter cavity after eight revolutions of the propeller. The shutter locking pin continues to hold the shutter in an unarmed position.

At the end of acceleration (burning), the setback spring (under the influence of creep) forces the pellets forward, withdrawing the shutter locking pin from the shutter cavity. This permits the shutter spring to pivot the shutter against the shutter stop pin. The shutter is secured in this firing position by the shutter detent. The firing pin, detonator, and booster lead-in now are in alignment and the fuze is fully armed. There is an arming delay of about 0.1 second after acceleration has ceased.

Upon impact with a target offering sufficient resistance, the firing pin is driven rearward, shearing the nose plate threads and piercing the detonator. The detonator initiates the booster lead-in and the lead-in initiates the booster.

This fuze is detonator safe. When the fuze is unarmed, the detonator is held out of line with the booster lead-in by the firing pin and shutter locking pin.

The firing pin cannot be withdrawn from the shutter cavity until the protective nose cap is removed and setback has occurred. The shutter cannot move the detonator in line with the lead-in until the propeller has made eight revolutions and withdrawn the firing pin, setback has ceased, and the setback spring has moved the shutter locking pin out of the shutter cavity. If the nose cap should accidentally become removed from the fuze, it would be necessary for a prolonged setback to take place at the same time that a turning force was applied to the propeller in order to arm the fuze.

The following precautions should be observed in handling this type of fuze.

1. If the fuze is armed, whether assembled in the rocket warhead or not, no attempt should be made to unarm it. If the fuze is armed, turning the propeller counterclockwise, as viewed from the nose, will cause the firing pin to pierce the detonator and set off the explosive train.

2. The fuze is safe as long as the cap assembly is held in place by the safety wire or the arming wire. If the cap assembly comes off by accident, the fuze is still safe as long as the propeller is engaged by the propeller locking pin. This can be determined by visual inspection. The fuze shall be considered armed if the propeller is out

of engagement with the propeller locking pin and is free to rotate.

3. Armed fuzes must NOT be fired from rocket launchers.

4. If the fuze in an assembled round is armed inadvertently, the propeller should be taped carefully to prevent further rotation. The fuze then should be unscrewed carefully from the rocket, taking care not to drop the fuzed round or the fuze on its nose, or strike the fuze in any way. This work should be done by explosive ordnance disposal personnel, if possible. If none is available, disposal should be as instructed by the officer in charge.

Typical Acceleration-Arming, Impact-Firing Nose Fuzes. All current fuzes for the 2.75-inch rockets have the same type of arming mechanism: an unbalanced rotor which drives a gear-train timing system in moving to the armed position. These fuzes do not employ arming wires or propellers; one of the design requirements was that they be free of external arming devices. Thus they can be made completely moisture-proof.

There are no base fuzes in 2.75-inch aircraft rockets.

DESCRIPTION. This fuze is armed by a required amount of acceleration over an established length of time. If acceleration of the rocket is too low or extends over too short a period of time, the arming mechanism will return to the unarmed condition. If the fuze is accidentally dropped on its base from a considerable height, it may become inoperable or the arming may be started. However, the arming cycle will not be completed because the inertial force of dropping is not sustained. Therefore the fuze is not made hazardous or unserviceable.

This type of fuze is housed in a one-piece body, figure 1–8. The internal components are inserted through the after end, which is closed by the booster cup. The plastic hammer and stab-type firing pin are secured in the nose by an antisetback shear washer and closing nut. The rotor arming mechanism, figures 1–9 and 1–10, consists of the rotor housing base, the unbalanced rotor, the gear train and escapement, and the setback weight. The setback weight floats on two springs surrounding two guide pins. The rotor is essentially disc-shaped. One segment is machined to a thin web so that, when mounted, the rotor is unbalanced. The heavy side of the rotor is diametrically drilled from two directions to receive the primer at the forward end and the detonator and delay element, if present, at the after end. The rotor lock roller is fixed to one face of the rotor. On the opposite side of the rotor is attached an annular gear by which the rotor drives the gear train of the timing mechanism. This gear train is supported between the inner and outer plates.

The axial movement of the setback weight is guided by the two guide pins and springs. A channel is milled on the outboard side of the weight to provide clearance for the side support. The U-shaped setback weight holds the lock roller to prevent the unbalanced rotor from turning to the armed position. When setback (acceleration of the rocket) causes the setback weight to move aft against its spring, the lock roller is released.

Setback causes the unbalanced rotor to turn to the armed position and the rotor's primer is aligned between the firing pin and the booster lead-in. The angular travel of the rotor is limited by the rotor stop, which is fastened to the inner plate.

A small spring-loaded detent is mounted between the inner and outer plates. A detent well, located in the rotor face, receives the detent when the fuze is armed. A detent-lock spring, mounted on the outer plate, provides a positive lock to hold the detent in the detent well.

A sealing disc and a sealing washer between the lead-in disc and the rotor housing base prevent the entry of moisture.

OPERATION. When the rocket is fired, setback forces cause the setback weight to move aft. This releases the unbalanced rotor which, in rotating, drives the timing mechanism. After turning 48 degrees, the rotor reaches its armed position where it is locked in place by the detent. The explosive train is now in line with the firing

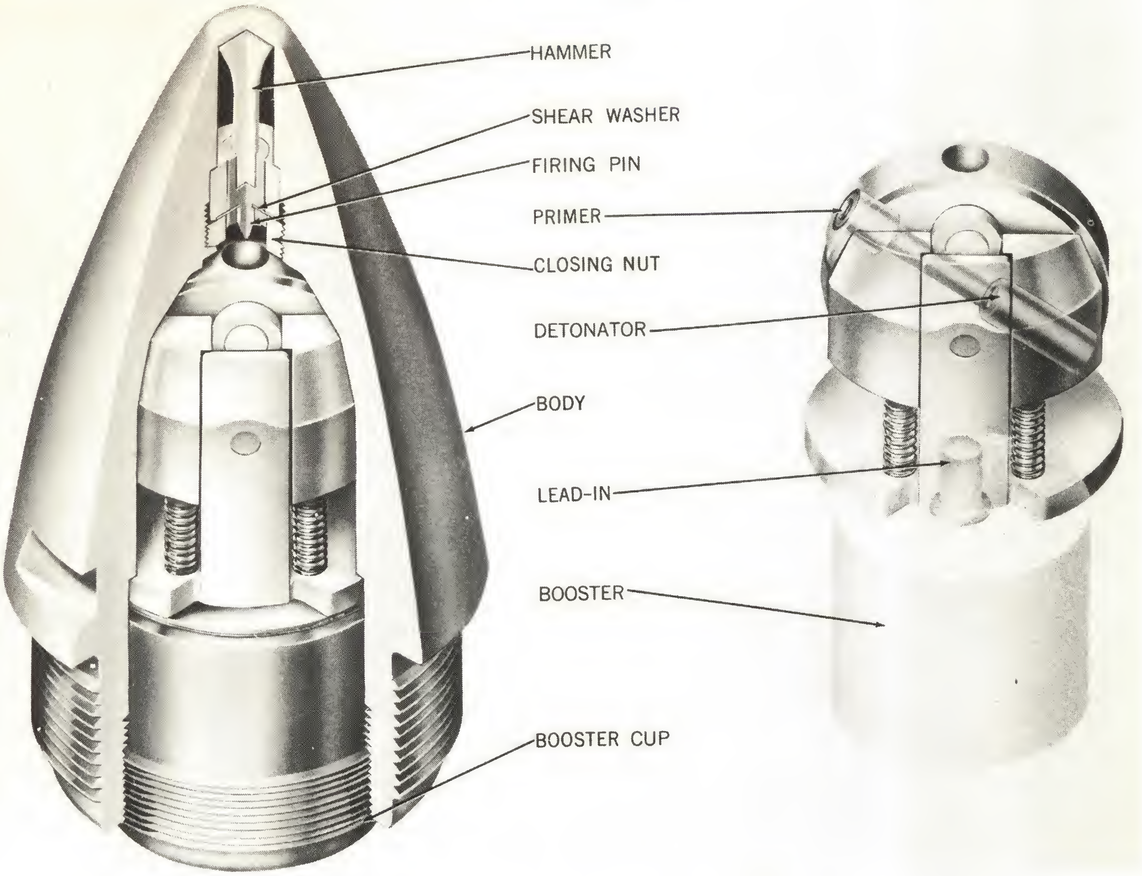


Figure 1–8. Typical Acceleration-Arming, Point-Detonating Nose Fuze in Unarmed Position: Cutaway View (left); Explosive Components in Unarmed Position, Phantom View (right).

pin and the fuze is armed. The time required for the rotor to reach the armed position is determined by the geared escapement which is driven by the annular gear on the rotor. The escapement's frequency is governed by the force applied to the gear train by the rotor, plus the position of the weight on the pullet lever or the weight of the "fixed" escapement, whichever is applicable. Since the force exerted by the rotor is the setback force received from acceleration of the rocket, the arming time of the fuze is a function only of the acceleration of the round, and the arming time can be varied due to the position of the nut or weight.

The arming mechanism provides for an arming distance of approximately 280 to 470 feet. The exact arming distance for a particular fuze is determined by the manufacturing tolerance in the arming mechanism and the rocket motor's thrust. The rotor will arm in less than 1.50 seconds when subjected to acceleration at approximately 20 g; when subjected to acceleration at approximately 40 g, it will arm within a period between 0.68 to 0.84 second. When the arming mechanism has been subjected to acceleration between approximately 13.5 g and 20 g, it will begin to arm. The setback weight will become partially retracted and the rotor will partially turn. When acceleration ceases, the spring will move the weight forward. The weight will bear

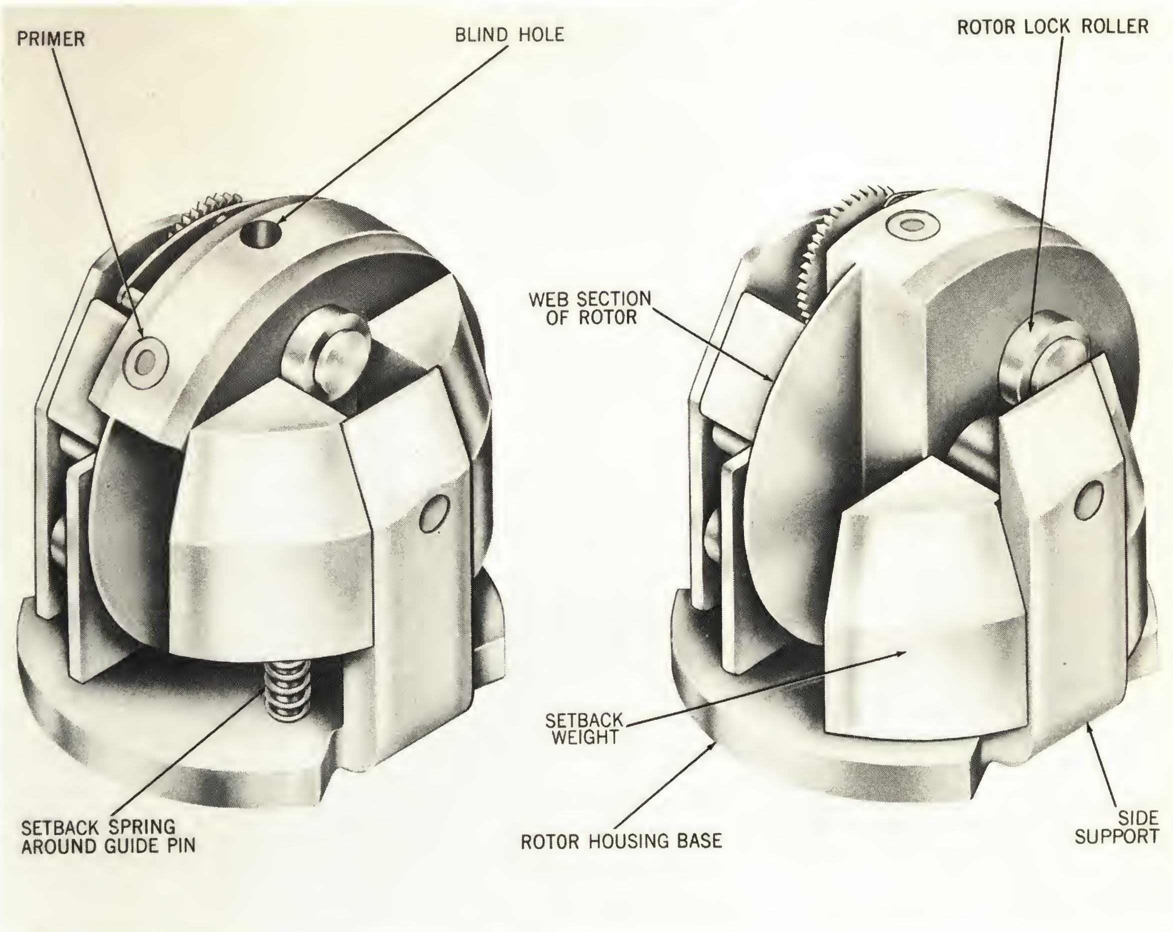


Figure 1–9. Rotor Arming Mechanism Removed from Fuze, Unarmed and Armed Positions, View from Right-hand Side.

against the rotor lock roller and drive the rotor back to the unarmed condition. When subjected to acceleration less than 13.5 g, the setback weight will not move and the rotor will remain in the unarmed position.

When the fuze strikes the target, the thin diaphragm in front of the hammer is crushed and the hammer drives the firing pin through the antisetback washer into the primer. This initiates the primer which, in turn, initiates the detonator, the lead-in, and the booster. Some fuzes of this type have a delay element between the primer and the detonator. This delay element is a slower burning explosive that is activated by the primer and burns for an established length of time before initiating the detonator.

Safety Precautions.

1. Acceleration-arming, point-detonating nose fuzes which are damaged to any extent should be considered hazardous items and disposed of accordingly.

2. Fuzes found corroded should be returned to an ammunition depot in the rocket warhead in which they are issued.

3. Removal of fuzes from their warheads is not permitted except at ammunition depots unless there is specific authorization.

4. Fuzes in rockets which have been fired must be considered armed. Since all the arming mechanism is inside the fuze, there is no method of visually determining whether the fuze is armed or unarmed.

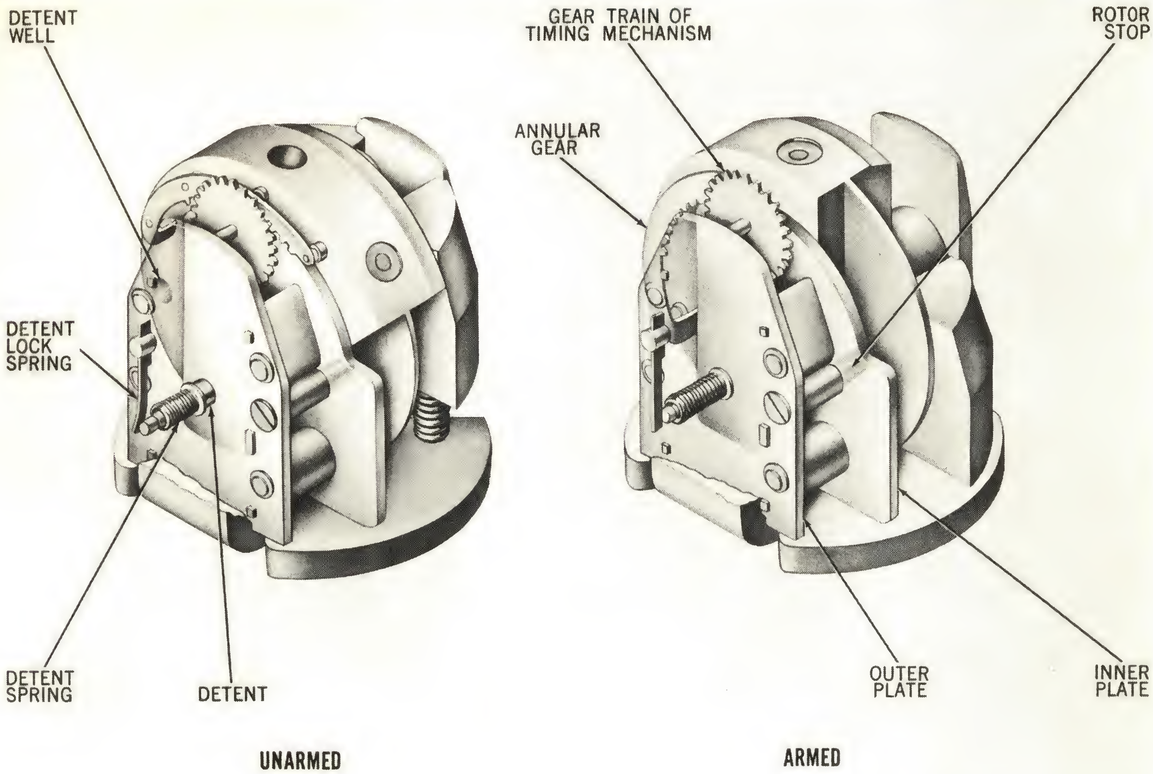


Figure 1–10. Rotor Arming Mechanism Removed from Fuze, Unarmed and Armed Positions, View from Left.

Typical Pressure-Arming, Impact-Firing Base Fuze. The main external parts of this type of fuze, figure 1–11, are the head, plug, inlet screw, inlet filter, body, and booster magazine. The head and plug contain the copper diaphragm, gasket, and rear portion of the arming plunger. The aluminum arming plunger is held in place by a plunger shear wire.

The arming plunger holds a locking ball in a position which secures the firing pin body and firing pin in the forward position, compressing the firing pin spring. While in the forward position, the firing pin extends through the firing pin guide and into a cavity in the shutter.

While the shutter cavity is engaged by the firing pin, the delay detonator assembly is out of alinement with the tetryl booster lead-in and the firing pin. When the firing pin is withdrawn, the shutter spring rotates the shutter, bringing the explosive elements in line.

Since the firing pin must not completely rupture the cover of the percussion primer, the firing pin is designed to shoulder against the face of the detonator case. Thus, the firing pin will only enter the proper distance into the primer.

To avoid crushing the detonator case by the weight of both the firing pin and firing pin body, the firing pin is secured in the firing pin body by the firing pin lock wire. On heavy impact, the inertia of the firing pin body shears the lock wire and the two parts telescope.

Gas from the burning rocket motor enters the pressure chamber through a small opening in the inlet screw. Debris in the gas is filtered by the inlet screen. The buildup of gas pressure is delayed by the small opening until approximately half of the propellant is consumed.

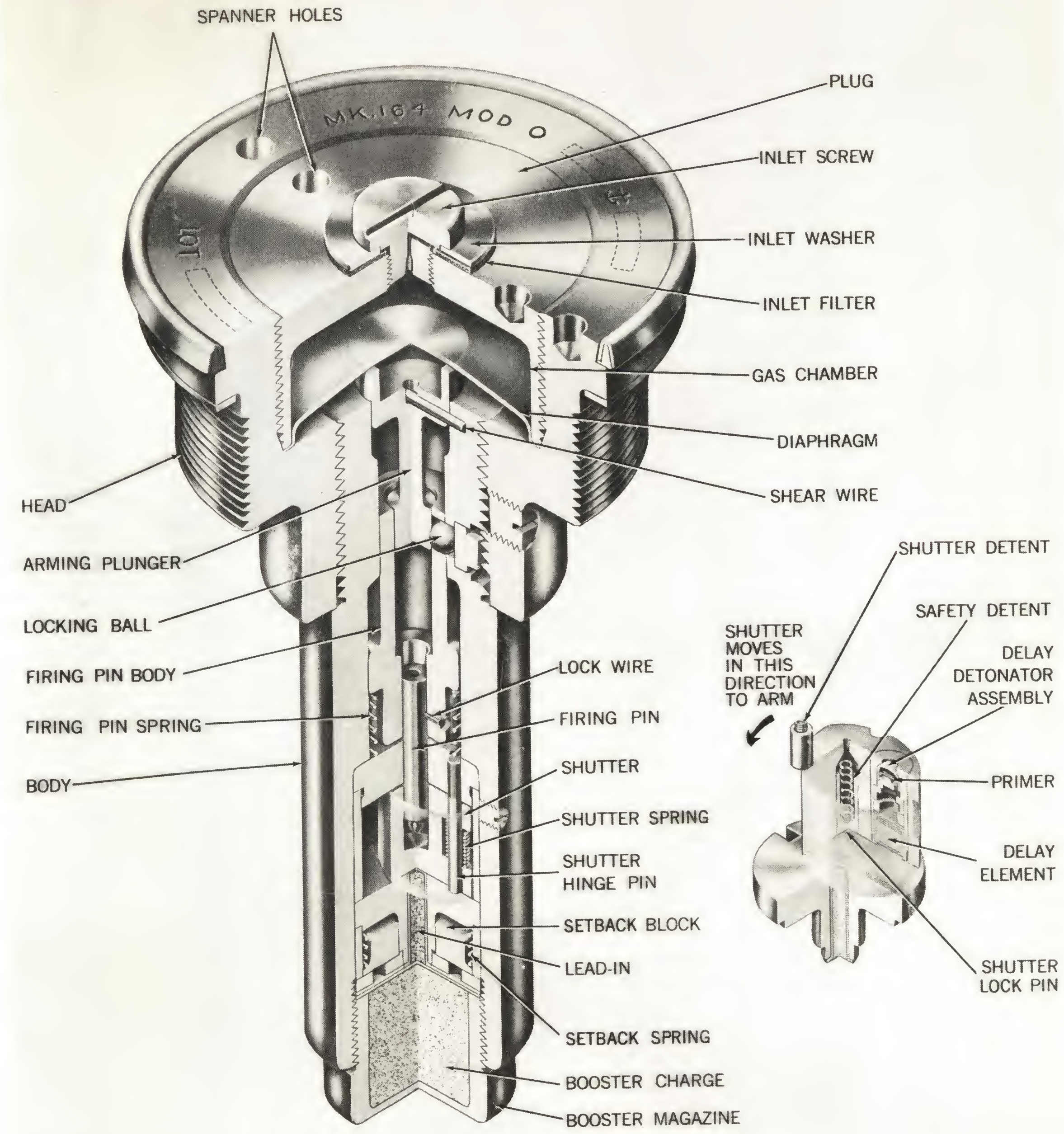


Figure 1–11. Typical Base Fuze (Pressure-Arming, Impact-Firing), Unarmed, Sectional View.

When pressure in the gas chamber reaches 275 to 325 psi, the diaphragm collapses, forcing the arming plunger down and shearing the plunger shear wire. Movement of the arming plunger releases the locking ball, which frees the firing pin body. The firing pin attached to the firing pin body is withdrawn from the shutter by the firing pin spring and inertia of the firing pin body.

Setback also pushes the setback block and shutter lock pin against the setback spring. The shutter lock pin engages the detent hole in the shutter and prevents the movement of the shutter to the armed position after the firing pin has been withdrawn.

When acceleration of the rocket has ceased, the shutter lock pin attached to the setback block is pushed forward by the setback spring, which has been compressed, and also by the safety detent. The shutter, in turn, is rotated into the armed position by its spring. The shutter then is locked in the armed position by the shutter detent.

On impact, the inertia of the firing pin body drives the firing pin forward, initiating the percussion primer. The primer initiates the black powder delay element. The delay element then initiates the tetryl lead-in and the tetryl booster which detonates the main charge of the rocket warhead.

This type of fuze is detonator safe. In the unarmed position, the detonator assembly is out of alinement with the rest of the explosive train. If the detonator assembly functions prematurely, the force of the detonation is dissipated upward through a hole in the firing pin guide and away from the rest of the explosive train.

Because of the controlled admission of gas from the rocket motor to the fuze pressure chamber, the first stage in arming does not occur until approximately one-quarter to one-half of the rocket propellent burning time has passed. Thus, if the rocket motor fails before it leaves the launcher, the fuze should not arm. Arming is not completed until after acceleration has dropped considerably. The burning distance, and therefore the arming distance, will vary with atmospheric temperature.

Since it is impossible to tell whether or not the fuze is armed from an exterior examination, the following precaution should be observed. If, for any reason, it is thought that the fuze may be armed, it should be treated as a hazardous item and disposed of accordingly. No attempt should be made to remove the fuze from the warhead.

Typical Deceleration-Discriminating Base Fuze.

This type of fuze, figures 1–12 and 1–13, consists of a steel body, a booster magazine, and a gas chamber plug. Inside the after end of the body is a double chamber formed by the plug, baffle cup, and diaphragm.

Gas from the rocket motor enters these chambers through the inlet valve. The diaphragm prevents the gas from entering the remainder of the fuze body cavity. Beneath the diaphragm, an aluminum arming sleeve is held in position by a shear wire. A pin through the arming sleeve engages a rotor, which is spring-loaded by a torsion spring.

Axial slots inside the rotor engage the arming sleeve pin and also the detonator plunger pin of the detonator plunger. Two trigger block locating pins pressed into the trigger block engage the rotor. A spring-loaded firing pin is contained in the detonator plunger; attached is the detonator case containing the primer and the detonator case lead-outs.

The detonator plunger assembly must be rotated 90° and moved forward to line up the lead-outs with the lead-ins. In the unarmed position, the detonator plunger assembly is restrained from moving forward the stop pins in the side of the fuze body. A locating pin in the fuze body serves to orient the detonator plunger assembly and rotor cap with respect to the fuze body.

The spring-loaded firing pin is held cocked by four lock balls which are held in place by the trigger block. The trigger spring is compressed between the trigger latch and a shoulder on the trigger block. The trigger block lock balls bear against the detonator plunger and a groove in the trigger latch.

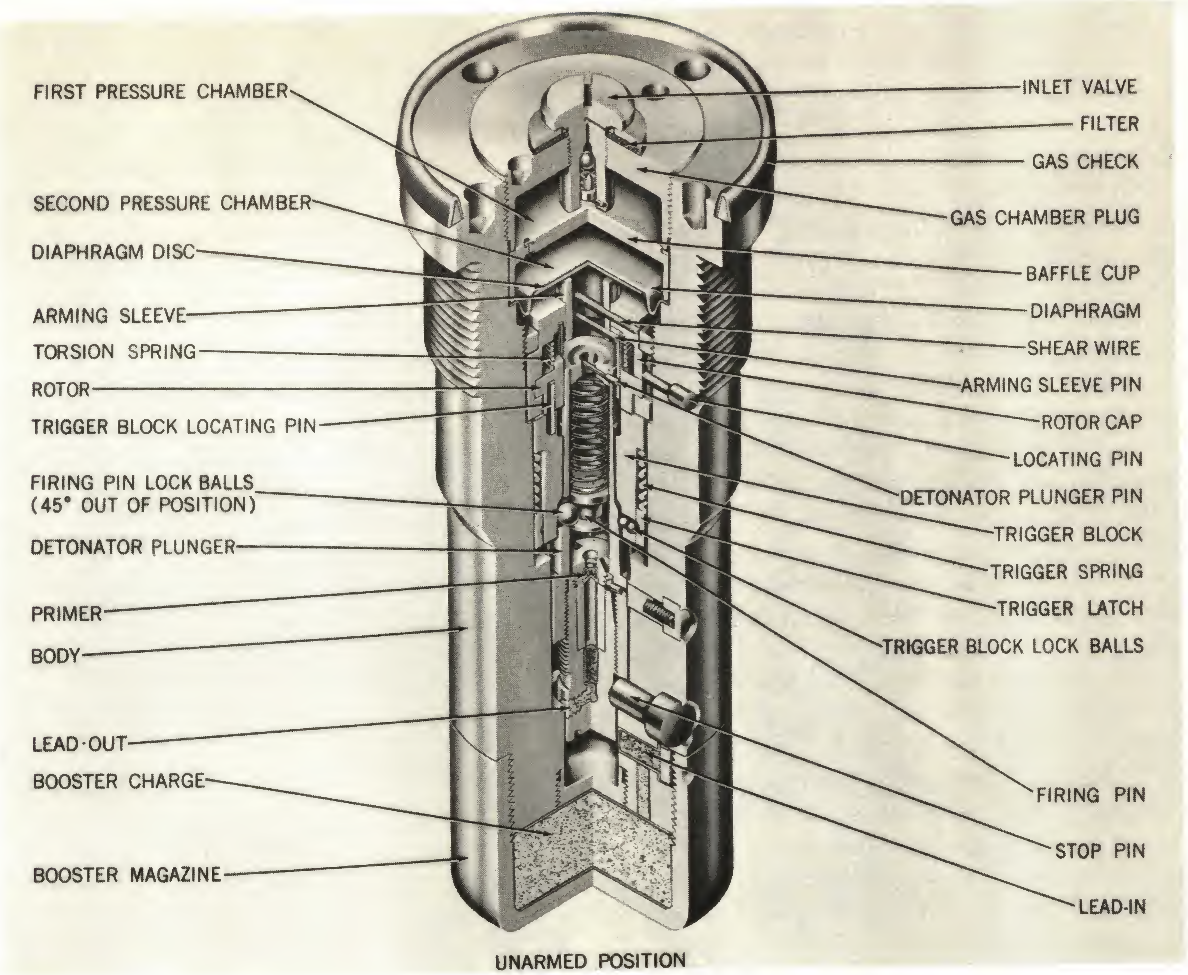


Figure 1–12. Typical Deceleration-Discriminating Base Fuze, Unarmed, Sectional View.

A closing plug closes the end of the body cavity.

Fuze arming is initiated by gas from the rocket motor, which enters through the inlet valve. Residue associated with burning of the propellant is filtered out by the wire mesh of the inlet valve filter. Gas pressure forces the inlet valve ball to compress the inlet valve spring, permitting the gas to enter the first pressure chamber. The gas then is allowed to flow at a slower rate into the second pressure chamber through a smaller orifice drilled in the baffle cup.

When the pressure in the second chamber reaches a value of approximately 525 psi, the diaphragm collapses, forcing the arming sleeve forward and shearing its shear wire. The time needed for the gas pressure to reach the arming pressure value of 525 psi is dependent upon the pressure of the propellent gases in the rocket motor which, in turn, depends upon the initial propellent temperature.

When the shear wire has been sheared, the arming sleeve and rotor are free. The torsion spring then can turn the rotor. The rotor, which also engages the detonator plunger pin and the trigger block (by means of the trigger block locating pins), revolves the detonator plunger-trigger block assembly 90° where it is stopped by the rotor stop pin, figure 1–13.

The lead-outs in the detonator case are lined up radially with the lead-ins in the

fuze body, but are still out of alinement along the longitudinal axis of the fuze. Slots in the end of the detonator plunger and stop pins in the body also are alined by the rotation. The detonator plunger-trigger block assembly now is free to move forward under the force of creep until the trigger block rests against the shoulder in the fuze body.

Friction of the firing pin lock balls on the trigger block prevents the detonator plunger from moving further forward until impact. Upon impact, the detonator plunger moves forward until it is stopped by the shoulder in the fuze body, figure 1–13.

At this point, the slots of the detonator plunger engage the stop pins, the detonator case lead-outs are alined with the body lead-ins, and the plunger is locked by the plunger detents. At the same time, the trigger block lock balls fall in behind the shoulder on the detonator plunger, releasing the trigger latch which was formerly locked with respect to the trigger block. This renders the trigger spring active. It is compressed between the shoulder on the trigger block and the shoulder in the fuze body cavity, and tends to force the trigger block toward the rear.

As long as the round retains its velocity, the inertia of the trigger block keeps the trigger spring compressed. As soon as velocity declines to the design limit, the spring overcomes setback forces while the inertia of the trigger block forces it to the rear, releasing the firing pin lock balls. The balls move outward and release the spring-loaded firing pin, figure 1–13. The firing pin initiates the primer which, in turn, initiates the detonator, the lead-outs, the lead-ins, and the booster charge.

This fuze is detonator safe. The detonator case lead-outs and the body lead-ins are out of alinement until after arming and impact with the water. The lead-outs and lead-ins are both longitudinally and laterally out of alinement until after the first two arming steps have taken place.

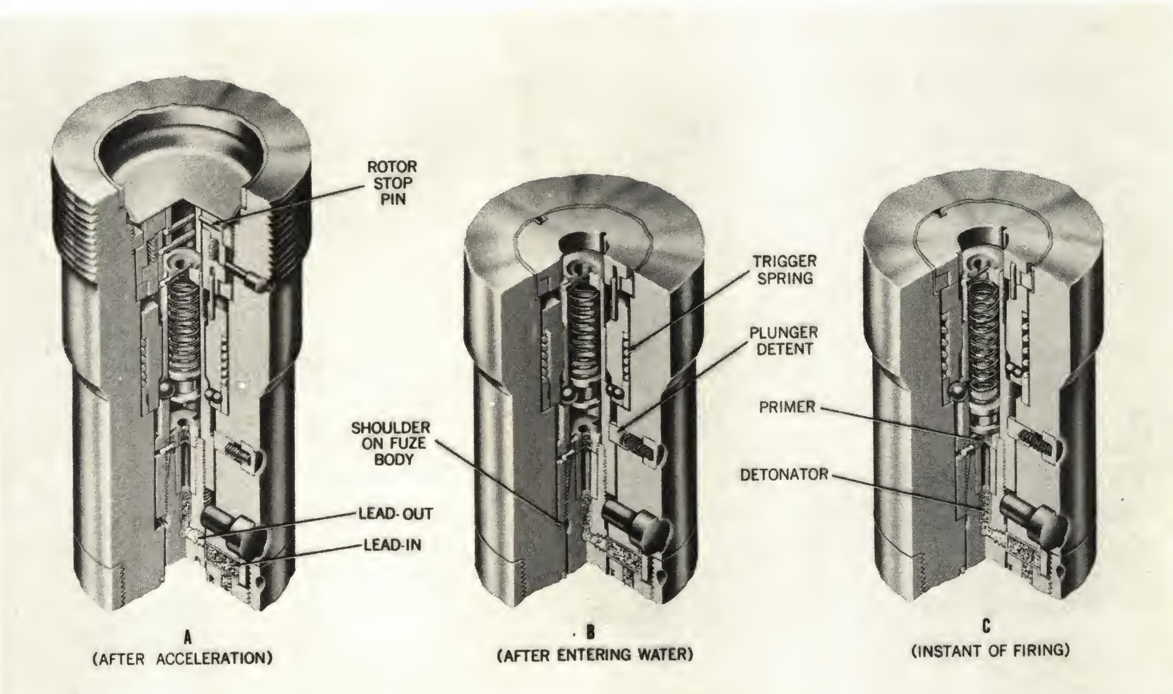


Figure 1–13. Typical Deceleration-Discriminating Base Fuze Mechanism: (A) after Burning of Propellant, (B) after Impact with Water, and (C) at Instant of Firing.

Because this fuze becomes quite sensitive after arming is completed and can be detonated rather easily, the following precautions should be observed. If an extremely light impact has occurred after the forces of gas pressure, spring, and creep have had their effect, the fuze may be fired by an additional slight jar. A fuze which remains unfired after heavy impact also is very sensitive, since it may be expected that the firing pin has struck the detonator, and subsequent friction between the firing pin and detonator may fire the fuze. In any event, the fuze or fuzed round should be considered hazardous and disposed of accordingly.

Rocket Details and Containers

Details. Rocket details are devices used in packaging and handling of the components. They are not attached to the rocket when it is in flight. They include such items as thread protectors on heads and motors, spacers in fuze holes to secure auxiliary boosters prior to installation of fuzes, short circuiting clips for electrical connectors, and fuze safety wires. These details are illustrated in the applicable chapters herein.

Details Peculiar to Folding-Fin Type Rockets

Head Shipping Support. This metal cup, figure 1–16, is assembled in the forward end of motors when shipping conditions require it. The support is currently used when warheads and motors are shipped in the same container, with the nose end of the warheads seated in the forward end of the motors. The head shipping support, which is held in place by three detents, protects the threads in the forward end of the motor.

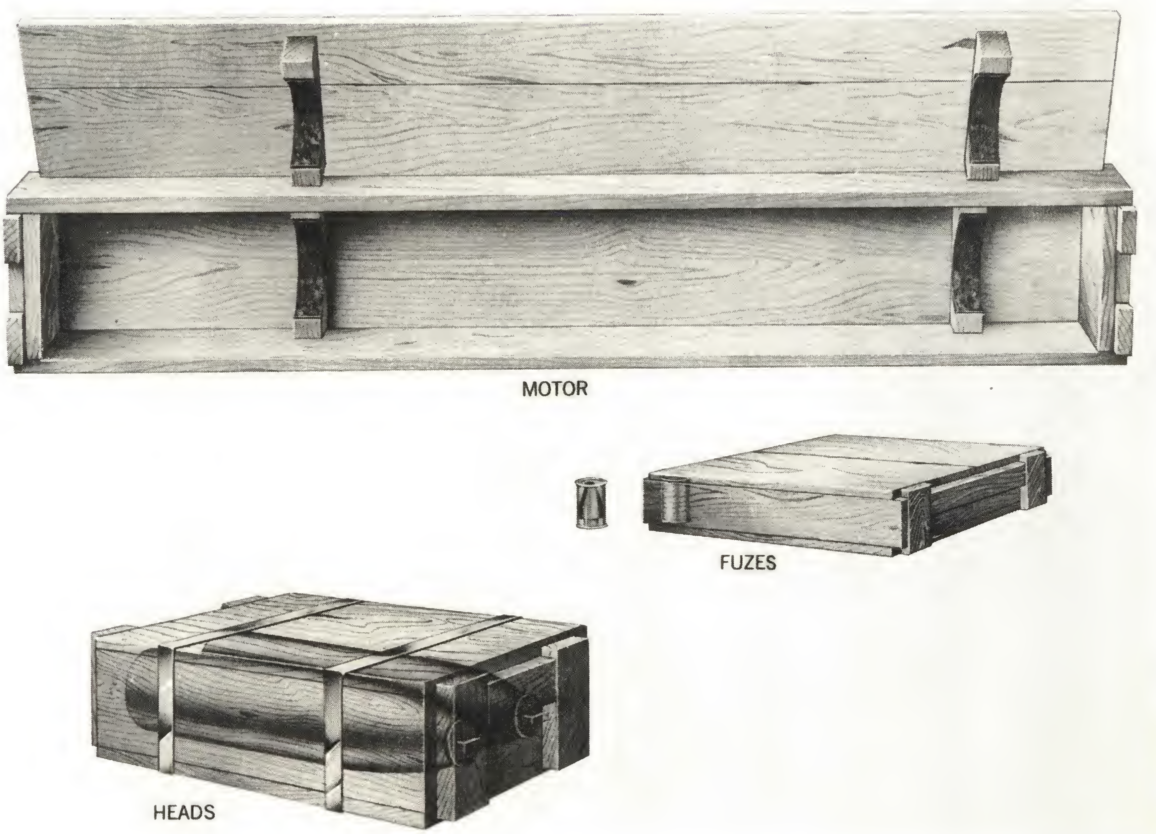


Figure 1–14. Typical Wood Containers for Rocket Components.

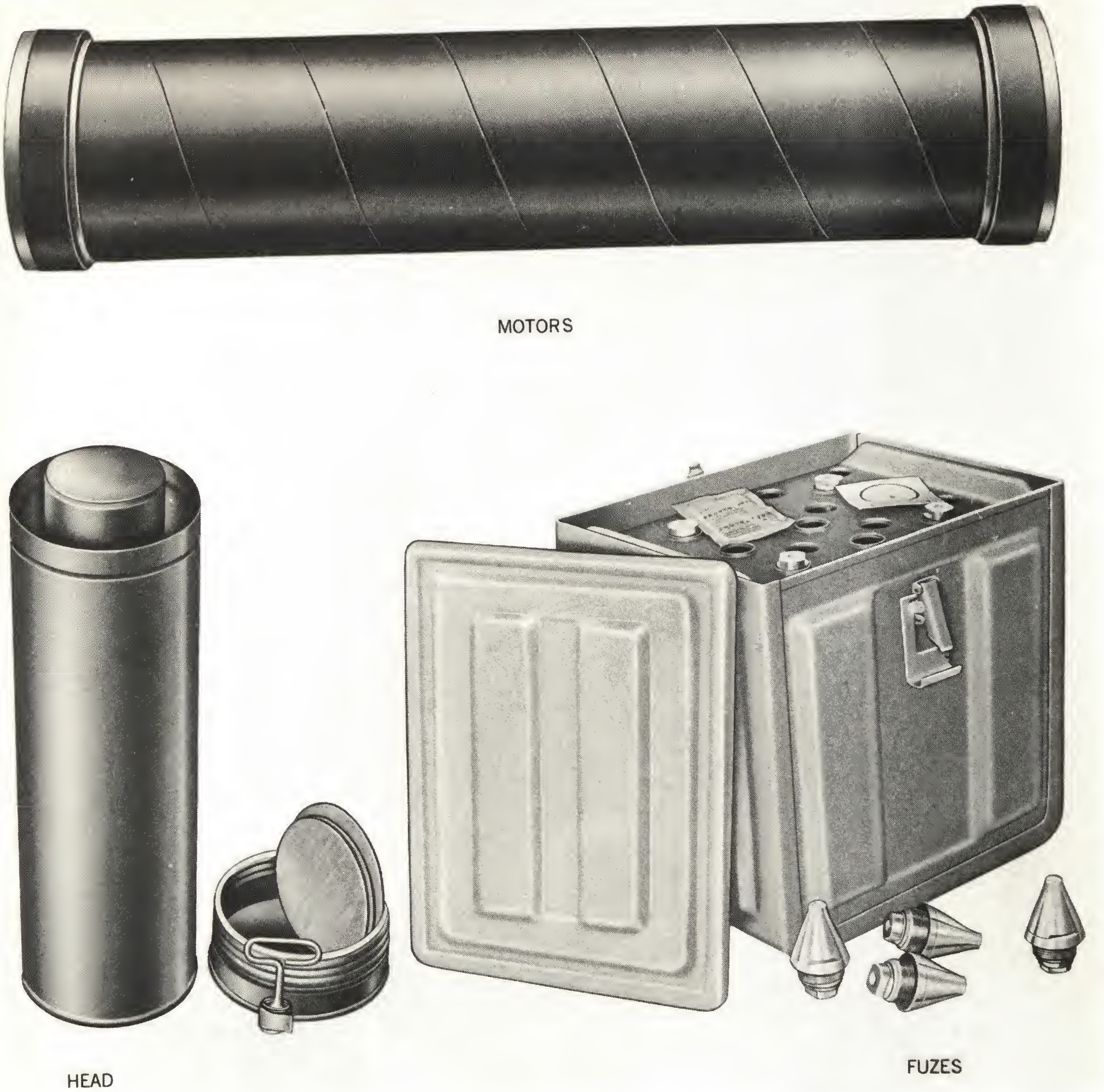


Figure 1–15. Typical Paper and Metal Containers for Rocket Components.

No head shipping support is required for 2.75-inch folding-fin aircraft rockets shipped and stored in Aero 7D shipper-launcher container packages.

Fin Protector. This elongated steel can, figure 1–17, is placed over the fin assembly to protect it during shipping and storage. The fin protector is not used when motors are shipped in combination launcher-containers. The protector is secured to a motor by detents which fit into the groove on the exterior of the nozzle plate. Riveted to the inside of the after end of the protector is a contact spring that presses the insulated contact disc on the fin retainer, figure 3–7, thereby short-circuiting the firing circuit of the igniter. This prevents accidental firing of a motor during transit and storage.

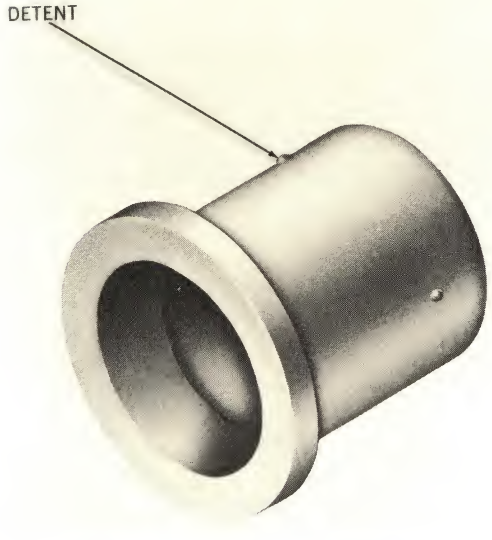


Figure 1–16. Head Shipping Support.

Containers. Current packaging for rocket components includes wood and metal boxes, metal cans, and paper and metal tanks, figures 1–14 and 1–15. Inside the containers are cradle blocks or spacers that secure the items. Rocket fuzes may be shipped in this manner or in individual, sealed cans. The outer container for fuze cans usually is a wood box.

Unit loads of the various types of containers, figure 1–18, are assembled for handling with powered equipment. If the unit load is one of motors with separate fin assemblies, these fin assemblies are included in the load. Some special unit loads are assembled by means of metal frames from items which are not packaged. Such metal frames and their accompanying pallet adapters should be stowed, after breaking out the items in the load, and returned to an issuing ship or station.

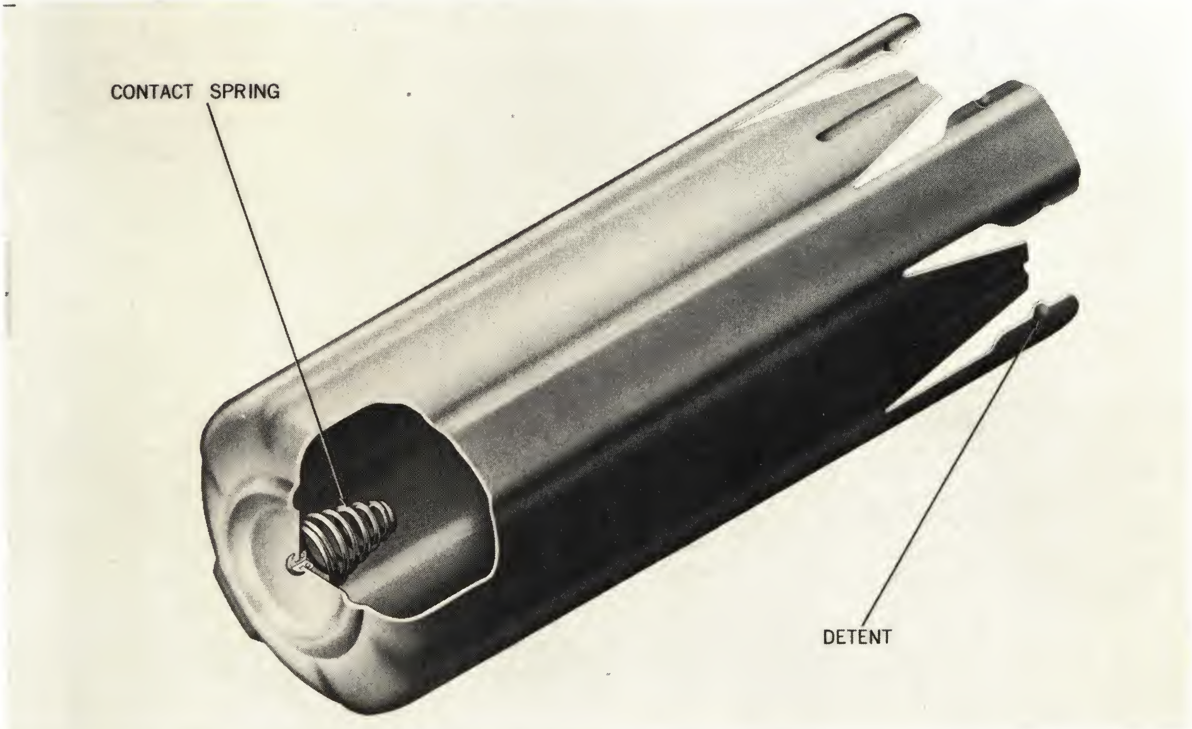
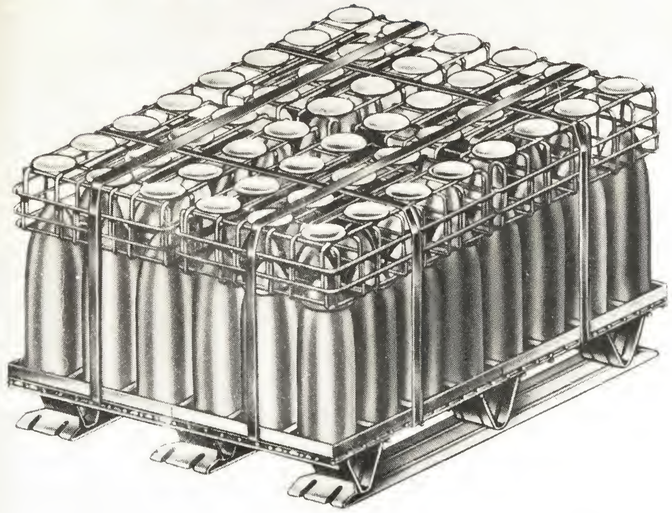


Figure 1–17. Fin Protector, Cutaway View.



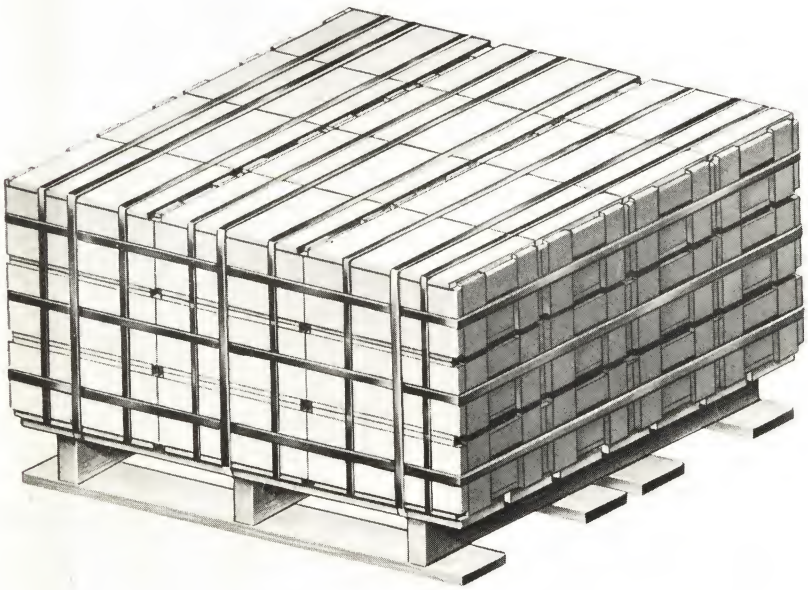


Figure 1–18. Typical Unit Loads of Rocket Components, Showing a Unit of Unpackaged Heads and a Unit of Packaged Heads.

Containers Peculiar to Folding-Fin Type Rockets

The following container types are currently used to package 2.75-inch rockets and components.

Head Containers. Steel ammunition boxes, figure 1–19, are used to package warheads assembled with their fuzes. These boxes are converted 20-mm cartridge containers; they are fitted with a lower support to se-

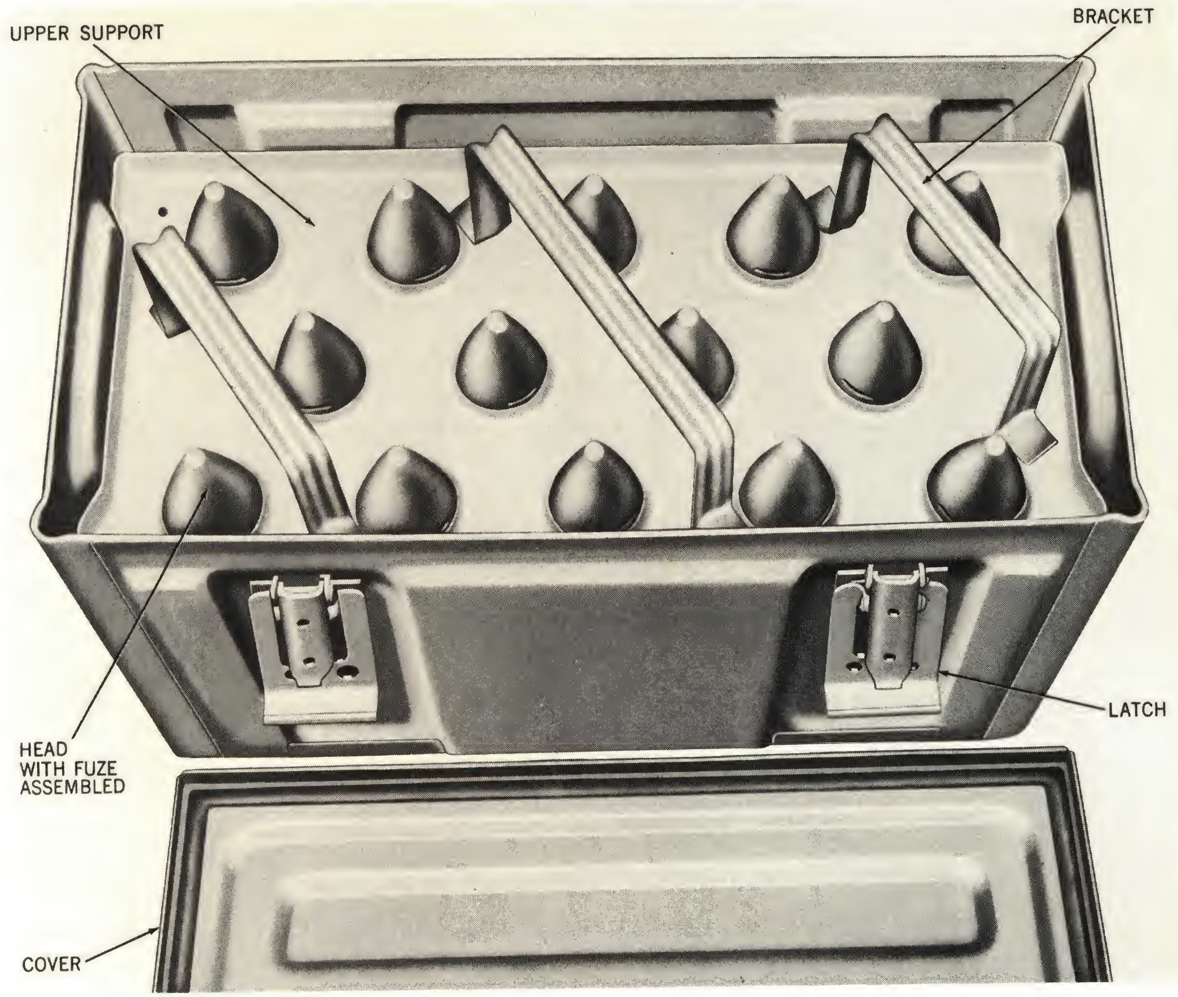


Figure 1–19. Typical Head Container for 2.75-Inch Rockets, Cover Removed.

cure the base of the warheads and an upper support to secure the nose section of the warheads. Brackets on the upper support serve to hold the upper support in place while the cover is on the box. The cover is secured to the box by latches.

To remove the warheads from the container, release the latches and remove the cover, remove the upper support by lifting on the brackets, and lift out the chipboard pad under the upper support. The warheads may then be taken out. The box contains 14 warheads.

This type of container should be saved and returned to an ammunition depot for reuse.

Warhead and Motor Containers. Reusable steel containers, figure 1–20, for shipping four complete rounds provide cushions on all sides of the rockets. A locking handle compresses gaskets on the cover against upper edges of the tubes in the body of the container to seal the assembly. In this type of container, a wire extractor is fixed to the motor of each round to assist removal of the round from the container. The bent end of the extractor is inserted in a hole near the forward edge of the fin protector. Pulling on the ring of the extractor will free a motor which might have become stuck against the plastic buffers on the inside of the container. The extractors should be re-

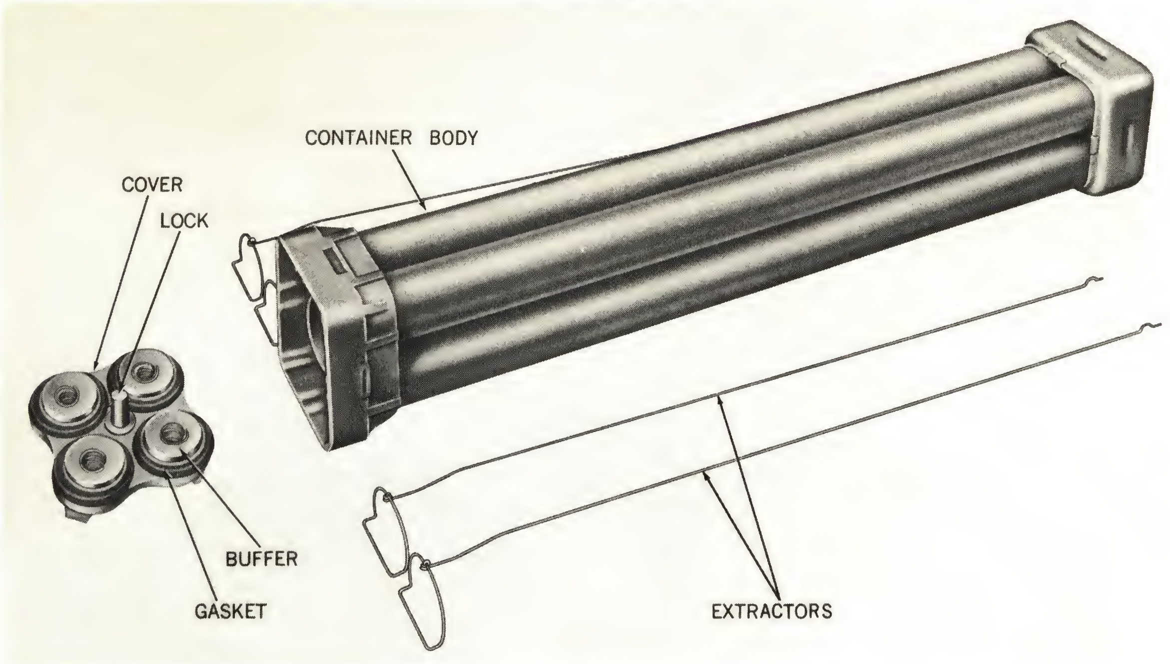


Figure 1–20. Container for Heads and Motors Shipped Together, Cover and Extractors Removed.

placed inside the container before it is stored for return to an ammunition depot.

This container may be used for ready-service stowage—under the special conditions and limitations imposed on this type of stowage. After the warhead is threaded to the motor, the round is placed in the container so that the motor of the assembled round is in the same location in the container that it occupied before removal and assembly. The extractor also occupies the same position in the container that it did before removal. The warhead on the assembled round will be in the same approximate location, but it will be pointing in the opposite direction.

In addition to those containers shown, there are presently in service several shipper-launcher-container packages: the Aero 6A, 7D, and 10D. The first two are used with the 2.75-inch folding-fin aircraft rocket. The last is used with ZUNI, a 5.0-inch folding-fin aircraft rocket. The Aero 6A and 10D shipper-launcher-container packages are used to store seven 2.75-inch and four ZUNI rocket motors, respectively. The Aero 7D launcher is designed to carry, from manufacture to service firing, nineteen 2.75-inch aircraft rockets. Warheads and fuzes for rockets used with the Aero 6A and 10D launchers are provided for as described in the preceding section.

Since the function of shipper-launcher-container packages is manifold and since function varies from one configuration of launcher to another, this publication treats them as separate rocket components. Particulars for the various configurations of shipper-launcher-container packages are given in chapter 7.

Rocket Operation

Launching. Launchers are used to hold and fire rockets. Various types are employed, depending on the aircraft and the rockets to be fired. Single, pylon-type launchers are not treated in this publication. Rockets must be fired only from the launchers authorized.

Rockets with electrical connectors make

contact by plugging into a receptacle on the launcher so that the igniter leads are joined to the firing circuit in the aircraft, figure 1–22. Some rockets are secured to the aircraft by the suspension buttons or bands which fit into slots and release devices on the launcher. The rocket is fired from the launcher when the firing circuit in the plane is energized.

Propellant Characteristics. The burning in a solid propellent grain proceeds perpendicularly inward from all ignited surfaces at a rate determined by the pressure in the motor tube and the temperature of the grain. This situation will prevail until most of the propellant is consumed. This condition is called "steady state of flow," "steady state," or "equilibrium." When the amount of burning surface, (and thus pressure) is decreasing, the condition is known as "regressive burning." If the amount of burning surface and pressure are increasing, the condition is known as "progressive burning."

Propellent grains burn from about 0.15 to 1.5 seconds, depending on their size, temperature, burning area, and shape. The rate of burning varies directly with the initial temperature of the grain. The final velocity attained by two rockets of the same type and launched under the same conditions, except for different propellent temperatures at the time of ignition, will be practically the same. However, the rocket launched at 100° F will have attained its peak velocity before the one launched at 40° F. This difference in time required to reach peak velocity will make a difference of a few mils deflection in the trajectories of the two rockets.

Very high propellent temperatures cause such a rapid rate of burning and high pressure that the motor tube may rupture. Very low temperatures cause the grain to burn unevenly, so that spurts of gas are emitted from the nozzles, called "chuffing", or the grain may disintegrate, emitting burning slivers of ballistite. When so fired, the rocket will travel only a short distance.

The firing of some rockets is limited to a relatively narrow temperature range compared to that suitable for the firing of guns. The present upper limit for these rockets is about 120° F; the lower limit about –20° F. The 2.75-inch and ZUNI rockets, equipped with motors that are relatively temperature-insensitive, operate satisfactorily between temperature limits of 165° F and –65° F.

Factors Affecting Trajectory. Other than temperature, these factors are those associated with the launcher, those associated with the rockets itself, those associated with the winds along the line of flight, and gravity.

Folding-Fin Rocket Operation

General. The operation of the 2.75-inch and ZUNI rockets is similar to that of other aircraft rockets except for the method of suspension, the igniter circuit, the fin assembly, the propellent grain, and the fuzes. The operation of the fuzes is described in a preceding section of this chapter; the other factors are treated in the following paragraphs.

Method of Suspension. Because of their folding fins, the 2.75-inch and ZUNI rockets are launched from tube-type launchers. See chapter 7 and the section in this chapter on Loading. Such a launcher eliminates the need for suspension devices on the rocket itself, except for the groove around the nozzle plate on the 2.75-inch and the forward end of the ZUNI motor. The groove receives a detent latch which is a part of the launcher tube.

Igniter Circuit. To facilitate firing 2.75-inch rockets from multiple tube launchers, there is no electrical connector assembly as with other aircraft rockets. One lead from the igniter is grounded to the nozzle plate, figure 3–6; the other lead terminates on the contact disc at the extreme after end of the motor, figure 3–7. The launcher firing circuit has an insulated terminal which touches the contact disc. The launcher latch carries the current from the nozzle plate to complete the circuit. When the circuit is energized, current flows through the

launcher's insulated terminal, through the contact disc, through the igniter, and returns via the grounded lead to the nozzle plate and the launcher latch. When the rocket fires, gases expelled from the burning propellant soon blast off the fin retainer with its contact disc and igniter lead.

Fin Assembly Functioning. When the motor is fired, figure 1–21, the fin retainer is blown off, freeing the fins. Gas pressure from the motor forces the piston and crosshead aft, pushing the crosshead against the heels of the fins. The launcher tube restrains the fins for a short period of time, with the fins exerting a force of about 2 pounds per blade against the tube.

As soon as the round clears the launcher, the crosshead forces each fin open to an angle of slightly less than 90° with the axis of the motor tube. Then, air resistance and setback forces return the fins to an angle of 45°, in which position the heels of the fins rest against the fully extended crosshead. The crosshead and fins stay in this position throughout the remainder of the flight.

The 5.0-inch folding-fin aircraft rocket (ZUNI) uses a different method of fin extension. Where the 2.75-inch rocket fins are extended by piston-crosshead action, ZUNI fins are blast operated. The heels of ZUNI fins are installed to lie over the nozzle cone. The first gases from the motor kick the fins open to latch on ratchet pawls. A small plastic fin retainer disc holds the fins closed before motor firing.

After the rockets are fired, the launcher package normally is jettisoned by the aircraft, although some configurations of launcher packages are reusable. See chapter 7. The parts of the container which were removed before assembling the warheads and loading the launcher package on the aircraft, the shipping end pans and motor retaining plugs, should be stored and returned to an ammunition depot for reuse.

Propellent Grain. The propellent grain in the 2.75-inch and ZUNI motors is made of a new composition which keeps the grain relatively insensitive to temperature changes. The trajectory of rounds with this type of propellant will be more stable and predictable than that of rounds having ordinary propellants.

The Launcher. The principal factor here is the length of the guide rail. Since the initial velocity of an aircraft-fired rocket is the same as the velocity of the aircraft, the launcher may be very short with no adverse effect on accuracy.

The Rocket Itself. The principal factors here are mechanical misalinement and gas misalinement. Mechanical misalinement is an effect resulting from the inherent imperfections in manufacturing and assembling the rounds. The axis of the nozzle is not likely to be exactly in line with the axis of the motor tube. The same discrepancy is likely in a multiple-nozzle plate assembly, resulting from axes of the nozzles, figure 1–5.

Since the motor usually is attached to the warhead by a threaded joint, it is not likely that the axis of the warhead and the axis of the motor are both coincident with the axes of their respective threads. By regulating tolerances in manufacture, these errors can be reduced to a low value but can never be eliminated.

In an assembled rocket, the distance between the prolonged axis of the nozzle and the center of gravity of the round is known as the mechanical misalinement. It usually is a few thousandths of an inch.

Gas misalinement stems from the fact that gas does not flow through a nozzle uniformly. If the flow were perfectly symmetrical and concentric with the nozzle axis, the line of thrust would coincide with the axis. Experiments, however, show that the line of thrust deviates from the nozzle axis by a small angle which is unpredictable in direction and magnitude. The causes are obscure and are presumably to be sought in the dynamics of the flow of gas down the motor tube and through the nozzle. It does not lend itself to easy measurement. The distance of the line of thrust from the cen-

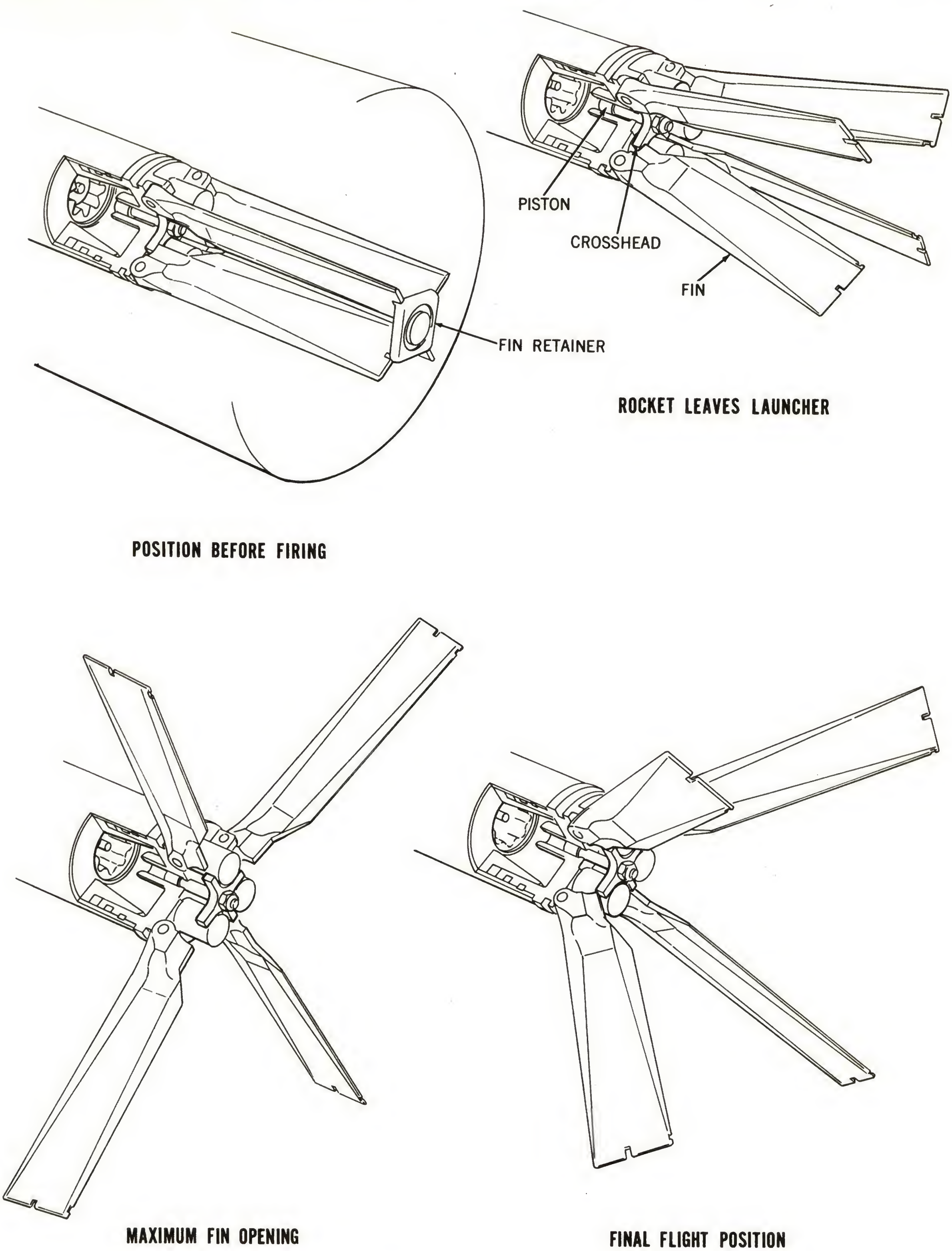


Figure 1–21. Phases of Fin Assembly Functioning, 2.75-Inch Folding-Fin Aircraft Rocket.

ter of gravity, owing to the action of the jet, is the degree of gas misalinement.

In any particular rocket assembly, the total misalinement is the vector sum of the mechanical and the gas misalinement.

Stable flight is accomplished by the fins on the motor tube. At launching, the restoring moment of the fins is dependent on the velocity of the aircraft. Important as it is, the immediate reaction of the rocket to "being on its own" represents but a few milliseconds of total trajectory time. Instability of the rocket during this period is not critical because of its rapid acceleration and the high restoring moment of its fins.

Winds Along the Line of Flight. The total effect of a crosswind is determined by the effects during burning and after burning. During burning, a crosswind tends to turn a fin-stabilized rocket into the wind. After burning, a rocket with fins will drift downwind, with its nose pointing slightly into the wind.

Gravity. This force accounts for the earthward curve of the rocket's trajectory. Although the effect of gravity is constant from the moment of launching until the round strikes its target, the effect is more apparent after the propellant has burned out and gravity is the main force acting on the rocket.

Figure 1–22 illustrates the phases in the flight of a typical aircraft rocket. In the (A) section of the illustration, the rocket is shown shortly after the igniter has been fired by the electrical firing circuit in the aircraft. The rocket is still attached to the launcher because sufficient thrust has not been generated to propel the rocket away from the aircraft.

Note that the case of the igniter has been ruptured by pressure from the rapidly burning igniter mixture. The propellent grain is beginning to burn from the heat of the igniter combustion. Note that burning takes place on the uninhibited surfaces of the propellent grain. The terminal of the electrical connector which was connected to the igniter leads is blown out of its seat in one nozzle seal by the mounting pressure in the motor tube. The outer nozzle seals also are blown out.

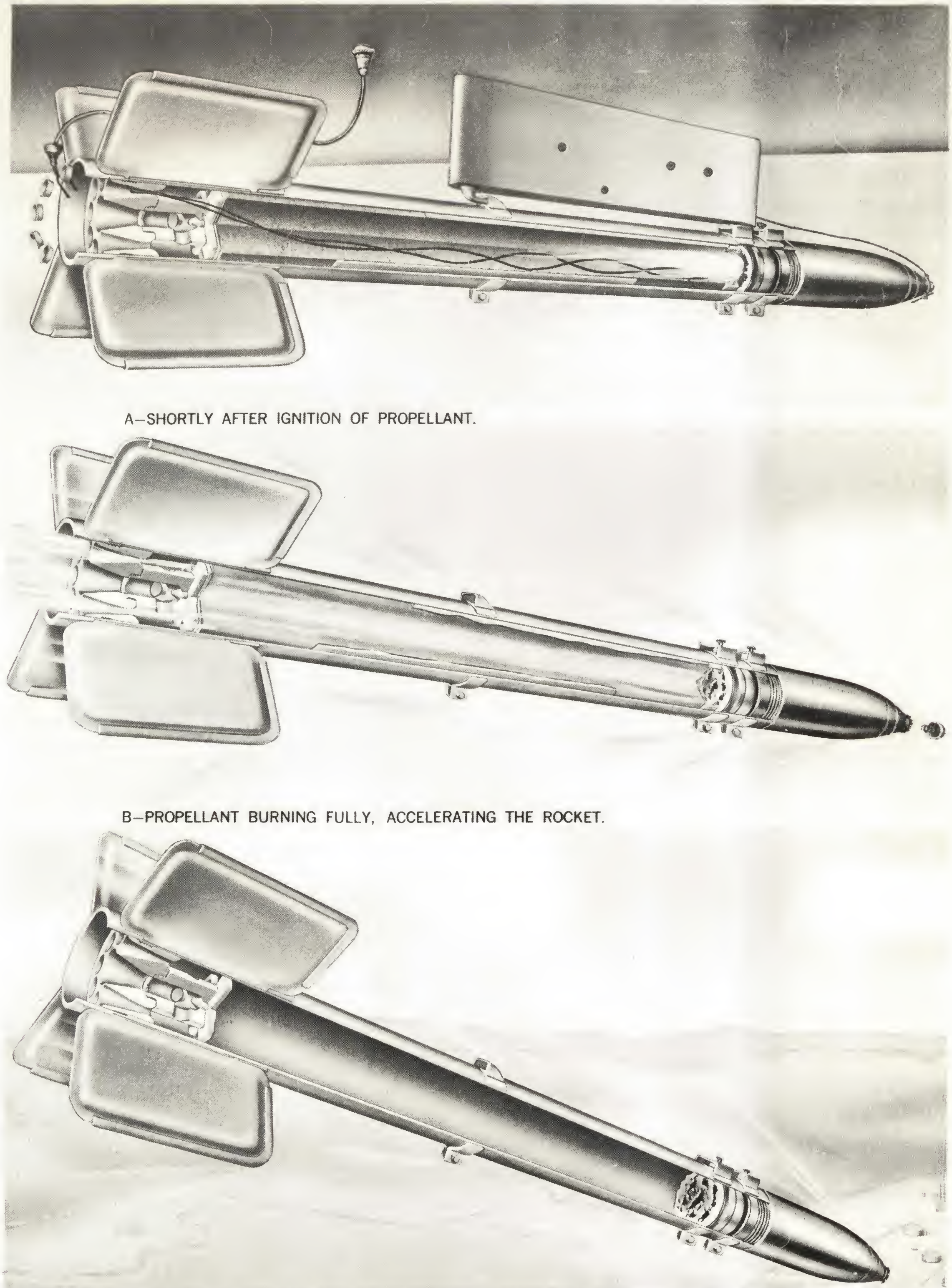
The other end of the electrical connector cable is weakened. It is weakened where it enters the plug which connects it to the receptacle in the wing of the plane. This weakened section of wire will be broken by the whipping action of the air stream, and the cable will be blown free of the plane.

The safety blowout disc in the central nozzle of 2.25-inch SCAR or 5.0-inch HVAR motors remains in place, unless the pressure in the motor tube approaches a level where it might rupture the tube. This blowout disc is insulated from the heat of the burning propellant by an asbestos cover. No action has taken place in the fuzes and none will take place until the rocket has generated enough thrust to move off the launcher, thus pulling out the arming wire on the nose fuze. One end of this wire secures the cap on the end of the nose fuze; the other end is secured to the launcher.

Launching Folding-Fin Aircraft Rockets. Folding-fin aircraft rockets launched from package launchers have approximately the same firing characteristics as the fixed-fin rocket shown in the (A) section of figure 1–22. However, the method and characteristics of rocket ignition, takeoff, and fuze armament differ.

Rocket Ignition. An intervalometer, an ignition spider on Aero 6A; see chapter 7, mounted on a bulkhead of the launcher receives power for the rocket ignition system from the 28-volt DC armament circuit of the aircraft. Contact with the launcher circuitry is made in either of two locations through a five-prong Cannon plug. On launchers where no option between ripple and single fire exists, a shunt-fuse intervalometer is used. The firing impulse is distributed to the rockets in 10-millisecond intervals by the intervalometer. Contact with each rocket is made through a one-piece, blast-operated detent latch in each rocket tube.

Launchers which provide an option of single or ripple fire are equipped with a



A—SHORTLY AFTER IGNITION OF PROPELLANT.

B—PROPELLANT BURNING FULLY, ACCELERATING THE ROCKET.

C—PROPELLANT EXHAUSTED AND THE ROCKET DECELERATING.

Figure 1—22. Phases in the Flight of an Aircraft Rocket.

rotary-type relay intervalometer and a fire selector switch. When this type of launcher is used on aircraft not equipped with a cockpit fire selector switch, the desired method of firing, ripple-optional or single, must be selected prior to takeoff. On aircraft equipped with a cockpit fire selector switch, the launcher selector switch must be oriented with the cockpit switch, after which the pilot will be able to ripple or single fire the rockets at his discretion. When the optional-fire configuration of launcher is used for ripple fire, the intervalometer converts the firing pulse into a ripple rate with a predetermined delay interval. If single fire is employed, the intervalometer relay rotates only one position each time a pulse is received. Here again, contact is made with the individual rockets through a detent latch in each rocket tube.

Launching. The significant difference between the launching of single, fixed-fin aircraft rockets and clustered, folding-fin rockets is the installation of fairings on the forward and after ends of the launcher packages. Like the rocket shown in section (A) of figure 1–22, a folding-fin rocket receives current, initiating its igniter mixture. Igniter combustion provides sufficient heat to start propellant burning. When enough thrust is generated by the burning propellent grain, the rocket leaves the launcher. See the section in this chapter on folding-fin rocket operation. Rocket exhaust disintegrates the after launcher fairing. The rocket warhead pierces and fragments the forward launcher fairing. Subsequent rounds are unobstructed. In most instances the launcher is jettisoned by the pilot after completion of firing. However some launchers, notably the Aero 10D launcher used with ZUNI, have a service life of many salvos and are not jettisoned unless it is tactically necessary. A separate electrical impulse is required to jettison the launcher.

Fuze Armament. Unlike fuzes used with many aircraft rockets, folding-fin rockets utilize fuzes with no external arming device. See the section in this chapter on the typical acceleration-arming, point-detonating nose fuze.

In the (B) section of figure 1–22, the propellant has completed half its burning. The rocket has moved well forward of the aircraft. The nose fuze has completed the first stage of its arming. The fuze arming wire was pulled off as the rocket left the plane, the nose cap has been jettisoned, and the propeller has rotated its full number of turns. See the section in this chapter on the typical air-travel-arming, impact-firing nose fuze. The base fuze has completed one stage of its arming, as gas from the burning propellant in the motor entered the gas chamber in the rear of the base fuze. See the section in this chapter on the typical pressure-arming, impact-firing base fuze. As long as the propellant is burning, the rocket is being accelerated. The round reaches its peak velocity at the end of this burning.

In the (C) section of figure 1–22, the propellant has been completely consumed by the burning. With the end of acceleration, the influence of gravity on the rocket's trajectory becomes more apparent, and the rocket's deflection from the line of launching becomes progressively more pronounced. Both the nose and base fuzes are completely armed, because both acceleration and deceleration of the rocket have taken place. See the fuze operation section of this chapter. Soon the rocket will strike the target; the impact will fire the nose fuze and, if the nose fuze does not function, the same impact will fire the base fuze.

Assembly and Disassembly of Complete Rounds

General. Fixed-fin, single-mounted aircraft rockets are not shipped in assembled form because of hazards involved. Some folding-fin aircraft rockets, however, are shipped and stored in shipper-launcher packages. The 2.75-inch folding-fin rockets, when used with the Aero 7D launcher, are shipped completely assembled in shipper-launcher packages. Rockets thus shipped consist of motors with fuzed warheads at-

tached. Fuzes for these rockets are not separate items of issue. The 2.75-inch folding-fin aircraft rocket may be shipped assembled because of its aluminum construction. If ignited from an external source, e.g., a fire in the magazine, the motor tube splits and the propellent grain burns nonexplosively. Similarly, an injury to the rocket tube wall may produce a weak spot, permitting splitting of the motor tube during ignition, resulting in a burning, but nonpropulsive, rocket motor.

In assembling complete rounds, only those combinations of warheads, motors, and fuzes which carry an assembly mark and mod designation in chapter 5 or in appendix A of this publication are permitted.

The general preparations and procedure for assembling and disassembling rockets, which are not shipped assembled, follow. The step-by-step sequence for particular calibers or marks is described in chapter 6.

In any operation involving assembly, disassembly, fuzing, unfuzing, cleaning, or painting, the work shall be done in the most suitable location, safely removed from other explosives and possible damage to vital installations. The smallest number of rounds practicable shall be exposed. Only personnel essential to the work shall be in the vicinity. The ideal situation is that where only one round at a time is worked at a location on deck remote from all magazines, ready stowage, other ammunition or explosives, and vital installations.

Precautions in Assembling Complete Rounds. Do not assemble or fuze rockets (except for authorized ready service rounds) until just before the plane is ready to be armed. If this is not practicable, assemble them as near to this time as is feasible. In any case, fuzing of rockets which are not authorized ready service rounds shall be delayed as long as practicable before arming the aircraft.

Removing Components from Containers. When opening containers, use nonsparking tools. Keep containers in a horizontal position while opening them. During the assembly procedure, keep the rocket warheads and motors in a horizontal position to decrease the possibility of accidents.

If components are in metal tanks or boxes, place in these boxes the details, such as spacers and thread protectors, removed from the component in preparation for assembly. Replace the cover on the metal container for return to an ammunition depot. Dispose of wood boxes in accordance with current directives. Enough containers of each type, including wood boxes, should be retained on board for return of faulty components to an ammunition depot.

As the components are removed from their containers, inspect them according to the following instructions. Repair or disposal of defective items is described under the section on maintenance and disposal in this chapter.

Head Inspection.

1. See that the warhead is not dented or cracked. A cracked warhead is hazardous.
2. See that the fuze adapter is staked to the warhead. A loose fuze adapter makes the warhead hazardous.
3. See that no threads have been damaged. This includes the threads in the fuze adapter and the motor adapter, if present.
4. See that there is no rust or corrosion.
5. See that the warhead contains a base fuze, if required.

> CAUTION: Do not attempt under any circumstances, to use a warhead that does not have its base fuze hole closed and gas-checked. Base fuze holes must be gas-checked regardless of whether a base fuze or a steel base fuze hole plug is used, as in the case of Warhead Mk 29 Mod 0.

6. See that the interior of the fuze cavity liner is clean. If necessary, wipe the cavity liner gently with a rag.

> CAUTION: Do not attempt in any manner to clean a fuze cavity which does not have a cavity liner.

In some instances, a hardened foreign substance both inside and surrounding the nose fuze cavity may be noticed. This may be present in sufficient quantity and hardness to prevent installation of a nose fuze. The substance is likely to be either NRC (luting) compound; or a heavier type of preservative, such as the wax-base preservative—Compound, Gun Slushing, 14C8 (ORD); or a mixture of the two, indiscriminately applied as a preservative. The hardened substance must be cleaned from the inside of the fuze cavity liner and the exterior of the warhead immediately surrounding the cavity. It may be cleaned from the cavity liner with nonmetallic brushes, or clean rags dipped in Trichlor-ethylene or alcohol. Trichlor-ethylene, Feb. O–T–634 Type II, is nonflammable and is preferred to alcohol. However, it is toxic and care must be exercised to provide adequate ventilation and to avoid exposure to Trichlor-ethylene over extended periods. The exterior of the warhead may be cleaned by scraping or brushing with spark-proof tools and brushes.

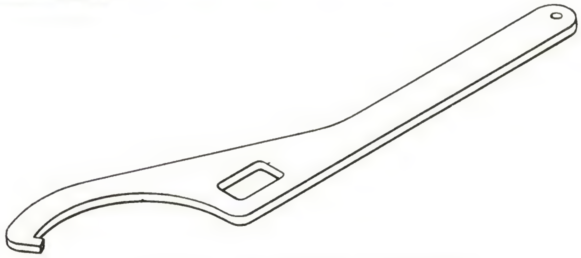
Cleaned and dried fuze cavities being returned to storage should be coated with a thin film of Bearing Grease MIL–G–16908. Avoid placing an excessive amount of grease in the cavity and on the threads; only a thin film is required.

Motor Inspection. Inspect the motor carefully and see that:

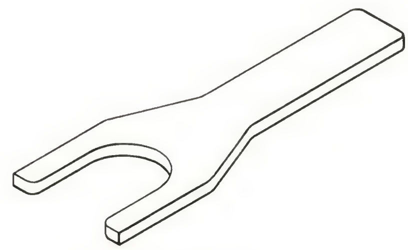
1. The motor is not dented or deeply scratched.
2. The safety short-circuiting clip or wire is in place on the electrical connector plug.
3. The front and rear closure discs, and nozzle closures are in place.
4. The fins are not bent or broken.
5. The electrical connector is not broken or the insulation damaged.
6. There is no rust or corrosion.

Fuze Inspection.

1. See that the fuze air vanes are not bent and that the body is not dented. Fuzes that are otherwise damaged, or that have loose or missing safety devices, or fuzes that are partially or fully armed MUST be considered hazardous.
2. See that the safety wires and pins, if used are properly in place.



UTILITY SPANNER WRENCH



FUZE WRENCH

Figure 1–23. Special Rocket Tools: Utility Spanner Wrench (top), and Typical Fuze Wrench (bottom).

Tools. No special assembly kits are currently issued for aircraft rockets. Tools which should be on hand include strap wrenches, stillson-type wrenches, fuze wrenches, the special wrench for the fuze being installed, and applicable spanner wrenches. A utility spanner wrench is issued for certain calibers. When shipper-launcher packages are used, the special tools described in chapter 7 must be available. A fuze wrench, figure 1–23, is included in every tenth box of fuzes, in addition to the original issue to a ship. Only this wrench should be used on the fuze being installed or removed. The spanner wrenches, figure 1–23, are designed for removing shipping plugs and caps, and for threading the warhead to the motor in a particular caliber of rocket. These special fuze and spanner wrenches are described in chapter 6.

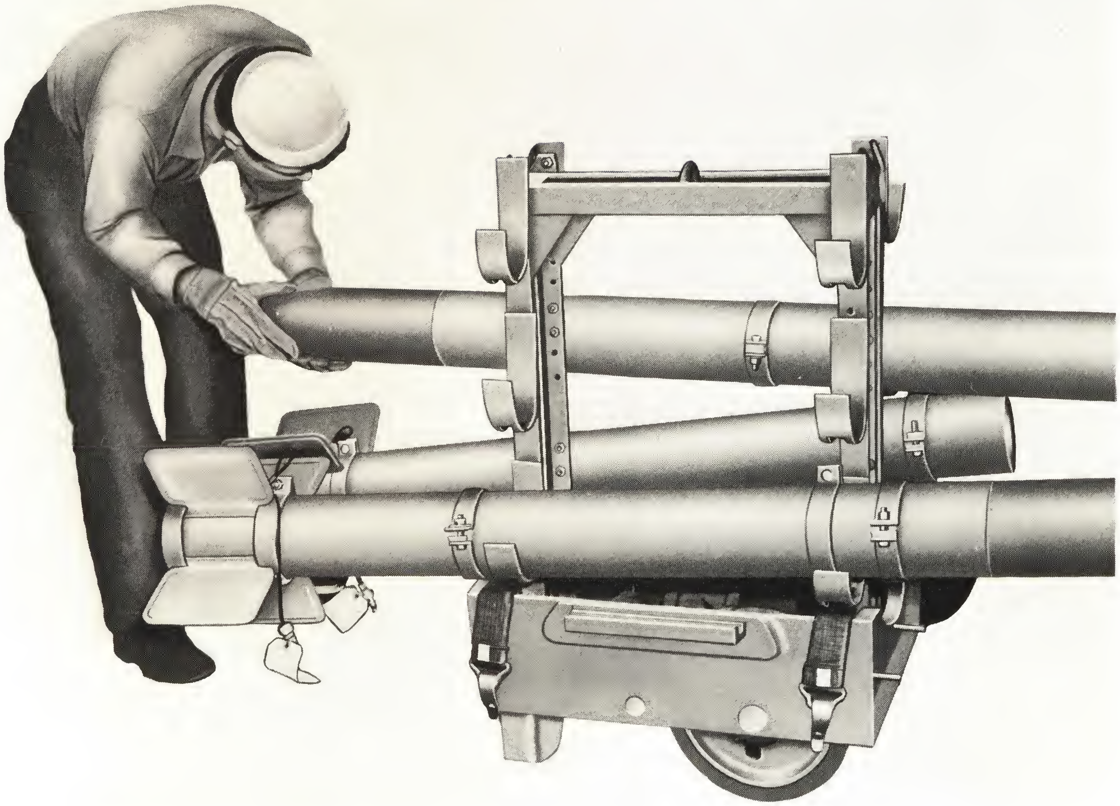


Figure 1–24. Installing Head, with Motor in Stirrups of Bomb Skid Adapter.

Assembly. The general procedure outlined is applicable to all current aircraft rocket assemblies, and these practices should be followed in assembling all rockets. The step-by-step assembly procedures for specific rockets are in chapter 6.

1. Place the motor in an assembly rack, figure 1–24, an approved vise, or set of bench clamps. If using a vise or clamps, do not squeeze a dent in the motor tube; damage to propellant or igniter might result.

2. Fit and secure the fin assembly over the nozzle end of the motor, figure 1–25, in the position described in chapter 6.

3. Unscrew the thread protector in the forward end of the motor. Be sure that the required washers or spacers are in the forward end of the motor. Do not disturb them; they insure proper spacing between the warhead and the front closure of the motor. Check the threads of the motor for dirt or damage.

4. Remove the thread protector from the base of the warhead. Inspect to be sure that the base fuze hole has a base fuze installed and is gas-checked. In the case of AP/ASW Warhead Mk 29, be sure that a steel base fuze hole plug has been installed and gas-checked. Check the threads of the warhead for dirt or damage.

5. Screw the warhead into the motor, figure 1–26, being careful not to cross the threads. This threading should be started by hand, and finished with a spanner or strap wrench.

6. Remove the rear shipping cap on the motor, if present. Do not remove the nozzle closure(s).

7. Remove the shipping plug from the nose of the warhead. Remove any gasket

and packing. Inspect the fuze cavity and threads for foreign matter or damage. If necessary, clean by wiping gently with a cloth. Do not attempt to clean a fuze cavity in which there is no cavity liner. See that an auxiliary booster, if required, is installed. Do not replace the shipping plug gasket when installing a fuze. Use a gasket under the fuze only if such a gasket is in the container in which the fuze is shipped.

8. Screw the nose fuze into the warhead by hand, being careful not to cross the threads, figure 1–27. Seat the fuze with the proper fuze wrench. Fuze wrenches are to be used only on the fuzes with which they are issued.

Generally, fuzing procedures, assembly procedures, and precautionary measures described apply to the 2.75-inch and ZUNI folding-fin aircraft rockets. However, by nature of their design and capabilities, certain procedural distinctions must be made for these rockets. Procedures used with

Figure 1–25. Installing Fin Assembly on 5-Inch HVAR Motor; Placing Fin Assembly on Motor Tube (top), and Secured Position of Fin Assembly (bottom).

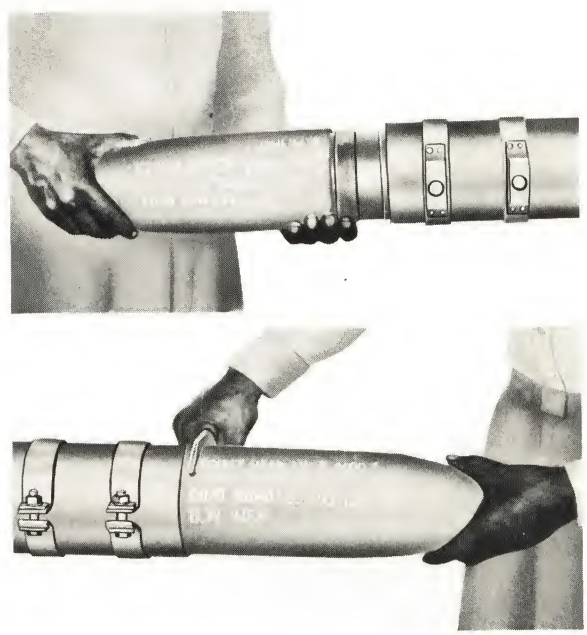


Figure 1–26. Threading Head into Motor of 5-Inch HVAR Rocket; Starting the Threading by Hand (top), and Seating the Head with Spanner Wrench (bottom).

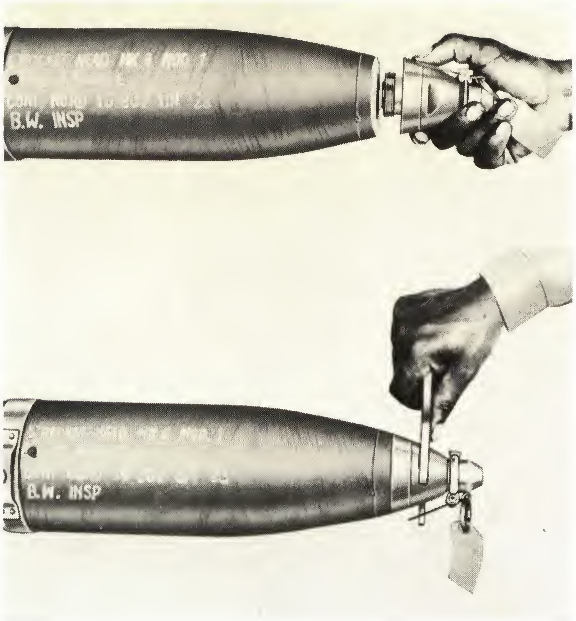


Figure 1–27. Installing Nose Fuze; Starting by Hand (top), and Seating with Fuze Wrench (bottom).

these rockets and their launcher packages are provided in chapters 5 and 7.

Precautions During Assembly.

1. Do not remove the fuze safety wires or clip at this time.
2. Do not remove the shorting clip from the electrical connector at this time.
3. Do not stand the assembled round on either end.
4. Protect the fins from damage during and after assembly.

Disassembly. Undamaged rounds are ordered disassembled by the officer in charge of the firing operation. Damaged rounds or rounds with armed or partially armed fuzes will be disassembled by explosive ordnance disposal personnel. If none is available, disassembly or disposal of rounds is ordered by the officer in charge.

Inspect rounds for defects before disassembling them into their component fuzes, warheads, and motors. In general, to disassemble rounds which are not defective, follow the assembly steps in reverse order. The step-by-step disassembly procedure for specific rockets is in chapter 6.

Precautions During Disassembly.

1. It is important that the fuze wrench designed for use with any particular fuze be used to remove the fuze from the round. Use of an improper wrench may engage the wrong holes, flats, or slots, and result in arming, functioning of, or damage to, the fuze.
2. If a fuze adapter becomes loose while removing the fuze, stop the operation. This is a defective round and is not to be repaired aboard ship. If grains of explosive are lodged between the adapter threads and warhead threads, unscrewing of the adapter may pinch and initiate the explosive.
3. Do not remove base fuzes, base plates, or nose fuze adapters from rocket warheads at any time.
4. No disassembly of rocket motor components as shipped is authorized. The rocket motor propellent grain is not to be removed from the motor tube except as authorized by Bureau of Naval Weapons directives.
5. Fuzes or firing mechanisms for rockets shall not be removed (except nose fuzes), disassembled, repaired, or in any way altered except as provided by special instructions from the Bureau of Naval Weapons.
6. Upon removal of components from the round, inspection of those parts of the components which could not be inspected when the round was assembled must be made before the components can be returned to stowage.

Loading and Unloading Rockets on Aircraft

The procedure to be followed in loading and unloading rounds depends on the particular launcher which is being loaded. This publication does not treat airframe-mounted launchers; however, it does concern itself with shipper-launcher packages, such as those described in chapter 7. The following practices in loading should be observed, regardless of the type of launcher.

Loading.

1. In warm weather, place a thermom-

eter on at least one rocket of each group coming from a separate magazine 10 minutes or more before loading. If the temperature of the rocket exceeds the safe temperature limits marked on the motor, do not load this group of rounds on planes until the rockets have cooled long enough to insure their being within the prescribed safe temperature limits. Load rockets from another magazine, after checking their temperature in the same way. Rockets should be maintained within the prescribed temperature limits for about 6 hours if they have been exposed to higher temperatures for 1 hour or more.

2. Do not remove the short-circuiting clip on the electrical connector of the rocket motor until just prior to plugging in the connector to the receptacle on the plane. Save the short-circuiting clip for possible reinstallation, in case the rocket is unloaded.

3. Do not plug in the electrical connector until the other necessary steps in loading all rockets on the launchers have been taken; for example, inserting launcher shear wires and nose fuze arming wires. Before plugging in the connector, make certain that the launcher firing circuit is open. Avoid rough handling in plugging in the connector; such roughness causes undue strain and wear on the receptacle. Use a straight push on the connector plug. If the plug feels loose in the receptacle, notify the officer in charge, since a loose connection might cause a misfire. The officer in charge may order replacement of this rocket.

4. After inserting a fuze arming wire, make sure that the fuze safety wire, if one is present, is removed.

Unloading.

1. As the first step in removing an unfired rocket from a launcher, be sure that the launcher firing circuit is open; then unplug the electrical connector. In removing the plug, do not jerk it or pull on the cable. Take hold of the plug and pull straight from the receptacle. Some rounds have been turned in to ammunition depots with the plugs pulled off the cable, an apparent result of rough, hasty handling to attain speed in rearming. Many misfires have been attributed to electrical connectors or receptacles damaged by rough handling.

2. Place the short circuiting clip on the electrical connector.

3. Insert the safety wire or clip in the fuze, and remove the fuze arming wire.

4. After unloading the round, inspect it thoroughly for possible damage. If the round is to be disassembled for return to stowage, inspect the components as they are disassembled.

Loading and Unloading Package-Type Launchers

General. Launchers for 2.75-inch and ZUNI folding-fin aircraft rockets consist of multiple, nested tubes that will ripple-fire or, in some configurations, single-fire the rounds. The same methods and precautions used for the handling of other aircraft rockets are applicable to these rockets. Detailed instructions for loading rounds into and unloading rounds from specific configurations of package launchers are provided in chapter 7. Generally, the following procedure is used.

Loading. Carefully insert the round into the launcher tube, with the round oriented so that the detent latch in the launcher tube does not strike a fin, until the detent latch seats firmly in the groove on the nozzle plate. Prevent the round from falling back against the rear of the launcher. This will avoid damage to the contact button or the launcher firing contact.

Unloading. After ascertaining that the launcher firing circuit is open, release the launcher latch and slide the round out of the tube. Use care in replacing the fin protector.

Loading and Unloading Rocket Launcher Packages on Aircraft

General. Detailed instructions for preparing and attaching specific configurations of launcher packages to aircraft are provided

in chapter 7. Generally, the following procedure is used.

Shipping Package to Aircraft Preparation. Remove supporting or spare parts and tools from the shipping package. Reinstall the package covers and extend and lock their handles in the carrying position. Open electrical receptacles, depress the shorting button, and install the correct configuration of hanger lug arrangement in the package wall hanger wells. Directions for arranging hangers may be found in the aircraft operating instructions.

Launcher to Pylon Attachment. Raise the launcher into position, using the launcher's extended locking ring handles. Aline hangers with those on the aircraft pylon hooks. On pylons using striker arms, instead of ignition cables, align the launcher contact post with the pylon's forward rocket rail slot concurrently with hanger alignment. On pylons not using striker arms, insert the pylon ignition cable plug into the nearest launcher receptacle. Securely latch the bomb hooks and tighten the pylon sway braces. On pylons using striker arms, rotate the striker arm to its down position. Remove the end cover, rubber shipping retainer, and shipping end from the launcher. When launchers do not contain assembled rounds, as the Aero 6A and 10D, screw rocket warheads into rocket motors. Instructions for installing rocket heads are provided in chapter 6.

Fairing Attachment. Frangible paper fairings are secured to both ends of each launcher. Fairings of this type have a metal band at their base equipped with lugs and a leaf spring clip. The lugs engage grooves in the center section end rings of the launcher. Rotate the fairing clockwise, until the spring clip drops into position to lock the fairing securely in place.

Launcher Armament Procedure. On aircraft using striker arms, drop striker arms. On other aircraft, attach the HVAR cable inside the ejector rack. Remove the shorting button from the launcher. Do not arm launcher armament until just prior to takeoff. When possible, hold the launcher shorting button up for pilot observation.

Unloading. Some configurations of package-type launchers are jettisoned after firing; others have a service life of many salvos. Detailed unloading instructions for specific configurations of package-type launchers are provided in chapter 7. Generally the following procedure is used.

1. Replace shorting button immediately after return from flight.

2. Remove fairings.

3. Remove rocket warheads from launchers in which rocket warheads are not stored, see chapter 7, and return to magazine stowage.

4. Replace end covers; extend and lock handles in carrying position. Disconnect launcher from airplane and return to magazine stowage.

Disposal of Misfires. In case a returning plane carries a misfired round, the same procedure for ordinary unloading should be followed. Where launcher packages are used, remove the misfired round as described.

> CAUTION: A 10-minute interval is to elapse between the last attempt at firing the round and any attempt to remove the round from the launcher. During this period the plane should be pointed in the safest direction possible.

When the defective round(s) have been removed, perform the following additional steps.

1. Inspect the electrical connector for damaged insulation on the cable or a damaged plug. If it appears that the electrical connector might have produced a short circuit, this motor should be returned to an ammunition depot. The motor must be tagged with a note indicating the damaged electrical connector.

2. Inspect the nozzle seal(s). If a seal is loose or missing, the igniter is to be considered fired. The motor is to be disposed of by dumping overboard. The dumping

shall be in water 500 fathoms deep, at least 10 miles from shore.

3. Remove all rockets from the plane and test the firing circuit of the launcher on which the misfire occurred.

> CAUTION: Do not test the launcher firing circuit until all rockets have been removed from the plane.

If a faulty launcher circuit caused the misfire, the rocket may be used again. If the launcher circuit was satisfactory, the misfired rocket, if a service round for operational use, should be disposed of by dumping overboard, as in step 2. Motors for training use which fail to fire on a training flight but show no apparent defect are to be loaded on a different launcher for a second flight. When such a motor fails to fire the second time and testing indicates that both the launcher circuits are functioning properly, the motor should be disposed of by dumping overboard.

4. Unscrew the warhead from the motor of the misfired round and inspect the front closure of the motor. If the closure is loose, the igniter is considered fired. The motor is to be disposed of by dumping overboard.

Reporting Misfires and Malfunctions. Ammunition Performance Report NAVORD FORM 1444 should be used in making these reports. If the form is not available, a report by letter should be made. All reports are to include the full ammunition lot designation of each motor; for example, RMBF–104–NFCH–52.

For misfires, the following information should be included in the report:

1. Result of testing the launcher firing circuit after misfire.

2. Result of examination of the electrical connector for damaged insulation or plug.

3. Result of visual examination of the motor's nozzle seal and front closure to determine if they were loose or missing.

4. Stowage temperature history of the motor from time of receipt on vessel.

For malfunctions, the following information should be included in the report:

1. Stowage temperature history of the motor from time of receipt on vessel.

2. Best estimate of the motor temperature at the time of firing, or the time and temperature history from the time the motor was removed from the magazine to the time of firing.

3. When possible, include photos of the motors.

Handling and Shipping

Handling. The precautions to be taken in handling rockets are the same as those taken in handling other Navy ammunition. The fundamental instructions follow.

1. Handle all components as little as possible.

2. Instruct personnel who will be involved in the handling as to the nature of the material. Only those men essential for handling should be in the area.

3. Personnel working with chemical rockets should have at hand protective gear. When entering concentrated smoke clouds produced by smoke rockets, men should wear gas masks.

4. No disassembly of basic rocket components is authorized except under instructions from the Bureau of Naval Weapons. This applies to heads, motors, and fuzes.

5. Do not use a circuit continuity tester to check the igniter circuit in a motor aboard ship. The circuit is checked before the motor is placed on board.

6. If dropped from a height exceeding 5 feet, a fuzed rocket warhead (whether or not in a container) shall be returned to an ammunition depot. If return to a depot is not practicable, the warhead shall be disposed of.

The general handling instructions for aircraft rockets apply to the 2.75-inch folding-fin aircraft rockets, except for the motors. These motors, if dropped from a height of less than 2 feet, should be examined for external damage. If no damage is visible, they may be considered safe for use. Motors

dropped from a height of more than 2 feet should be treated as defective items.

Shipping. Ordinarily, service-loaded warheads, motors, and nose fuzes are shipped separately. The exception to this is the 2.75-inch folding-fin aircraft rocket, which is often shipped assembled. When used with the Aero 6A shipper-launcher-package, see chapter 7, the 2.75-inch rocket is shipped disassembled; its rocket motors are shipped and stored in the launcher, and its fuzed warhead is shipped and stored as described in the section of this chapter on containers. When used with the Aero 7D shipper-launcher package, see chapter 7, the 2.75-inch rocket is shipped and stored completely assembled.

The 5.0-inch ZUNI folding-fin aircraft rocket is shipped disassembled; its rocket motor is shipped and stored in the Aero 10D shipper-launcher-package, see chapter 7; its warhead is stored separately as described in the section of this chapter on containers.

Practice rockets, with head and motor unassembled, may be shipped in the same container. Base fuzes are shipped installed in warheads. Typical containers for rocket components are illustrated in figures 1–14 and 1–15, and shipper-launcher-container packages are described in chapter 7.

When it is necessary to return components to ammunition depots, use packaging which will afford at least as much protection to the item as did the container in which the item was received.

Stowage

Rocket warheads, motors, and fuzes present different types of hazard—explosion, missile or fragmentation, and fire; consequently, they should be stowed separately.

Heads. Rocket warheads loaded with high explosives, which are shipped unassembled with motors in a single tank, shall be stowed in magazines aboard ship similar to primary projectile magazines, as defined by the Bureau of Naval Weapons Manual. Stowage arrangements are to be in accordance with rules in OP 4 or OP 5, as appropriate for the stowage of separate-loading projectiles. Rocket warheads are to be stowed with shipping caps in place.

Rocket warheads loaded with chemicals shall be stowed in dry, well-ventilated enclosures on the upper decks, convenient for jettisoning in an emergency. These warheads should not be stowed with high-explosive warheads, unless otherwise authorized by the Bureau of Naval Weapons.

The instructions for storing other aircraft rockets apply also to the 2.75-inch and ZUNI folding-fin aircraft rockets. Motors packed in combination launcher-containers, such as the Aero 6A and 10D, see chapter 7, and assembled 2.75-inch folding-fin rockets packed in the Aero 7D shipper-launcher-container, see chapter 7, may be stored in magazines ashore and afloat as received. Outside storage of these containers is limited to 180 days because of their paper and fiberboard construction. If, in an emergency, outside storage is all that is available over this period, the rocket motors in the containers are to be turned in to an ammunition depot for inspection, overhaul, and repacking in new launcher-containers.

Ready-Service. The limitations on ready-service storage of assembled rockets, because of the greater risk of missile damage and because of the risk of deterioration from exposure, apply to 2.75-inch folding-fin aircraft rockets also. Storage of assembled rockets under these limited conditions in the four-round container, figure 1–20, is preferred to exposed storage.

Solid and inert-loaded practice rocket components may be stowed in locations for convenience. These are inert materials and shall not be stowed in magazines. However, they must be protected from moisture so that the threads and exterior surfaces will not rust.

Motors. Rocket motors are stowed in primary smokeless-powder-type magazines. Ready-service magazines, compartments, or lockers, as defined by the Bureau of Naval Weapons Manual, may be used for stowage of small numbers of assembled rockets. The propellent grains must not be exposed to

abnormal temperatures. Prolonged stowage of rocket propellants, except for those used with 2.75-inch and ZUNI folding-fin aircraft rockets, at or above 100° F is hazardous. Since shipboard surveillance tests are not authorized, the oldest propellent lots shall be used first for maximum safety.

Motors which have been stowed in high temperatures should receive special attention, as follows:

90°–100° F.—No action necessary.

100°–110° F.—Employ artificial cooling as practicable.

110°–120° F.—1. Employ artificial cooling as practicable.
2. Segregate this ammunition and load it first for firing.
3. Make a special record of the number of hours in which the motors have been in temperatures above 110° F. When the cumulative total of hours above 110° F reaches 500, segregate these motors and turn them in to an ammuninition depot at the first opportunity.
4. Record also the maximum storage temperature reached in each hour of exposure to temperatures above 110° F.

120°–130° F.—1. Employ artificial cooling as practicable.
2. Segregate these motors and turn them in to an ammunition depot at the first opportunity.

Above 130° F.—1. Turn in to an ammunition depot immediately.
2. If no depot is immediately available, consider these motors hazardous and dispose of them accordingly.

Rocket motors for the 2.75-inch and ZUNI folding-fin aircraft rockets are relatively insensitive to temperature. Both of these rockets function normally between temperature limits of —65° F and 165° F. These limits also apply to their stowage.

Stowage of unboxed rocket motors aboard a combatant ship, 20 percent with fin assemblies attached, is authorized. When stowing unboxed motors, figure 1–28, the following regulations apply.

1. Motors must be supported at two points. For 5.0-inch motors, the distance between supports should be 15 inches or greater, with the supports approximately equidistant from the center of the motor. There must be no interference with the suspension bands.

2. Motors must be secured against shifting or other motion.

3. Stacking in any manner whereby the motors rest upon each other is not permitted.

4. Motors must be stowed in a horizontal position.

5. Electric components must be protected against breaks and short circuits.

6. External fittings and projections must be protected.

7. Metal parts must be protected against deformation. This will avoid damage to, or dislocation of, the propellent grain.

8. Motors shipped in the Aero 6A and 10D shipper-launcher-container packages, see chapter 7, and assembled 2.75-inch folding-fin aircraft rockets shipped in Aero 7D shipper-launcher-container packages, see chapter 7, may be stowed as received. The 2.75-inch folding-fin aircraft rocket may be stored assembled, see the section of this chapter on details and containers, because of the split tube safety feature incorporated in its motor tube design. If ignited from an external source, these motors split and burn nonexplosively. Rockets other than these should not be stored assembled without specific approval of the Bureau of Naval Weapons.

Fuzes. Separately issued nose fuzes which contain detonators or other explosive components shall be stowed only in designated fuze magazines. These fuze magazines shall not be located adjacent to magazines containing high explosives.

Nose fuzes are to be removed from their wood outer container and stowed in their individual inner containers. Base fuzes are

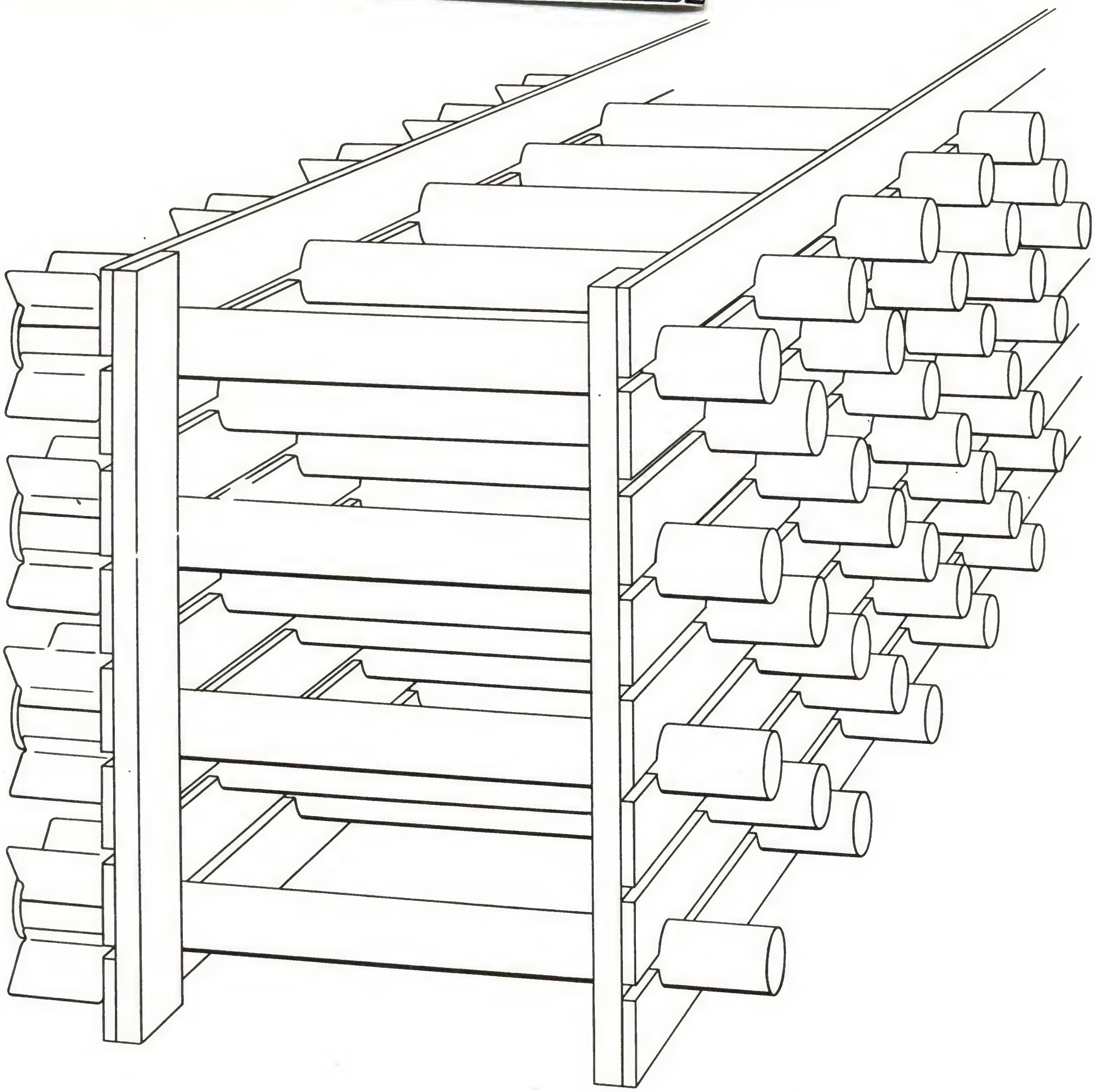


Figure 1—28. Typical Magazine Storage of Unboxed Rocket Motors.

shipped permanently installed in their rocket warheads.

Fin Assemblies. These and other inert components may be stowed in any suitable space other than ammunition magazines. Stowage of uncrated fin assemblies in the vicinity of the rocket assembly area is authorized, provided the fin assemblies are rigidly secured.

Stowage Precautions.

1. Stow rocket motors separately from rocket warheads where possible. The motor is not propulsive unless joined to the warhead.

2. Rocket warheads for which fuzes are issued separately shall not be stowed with those fuzes installed in or near magazines containing explosives. If rocket warheads, for which fuzes are issued separately, are

returned to the magazine with fuzes installed, remove fuzes or, as for the 2.75-inch FFAR, store the assembled rocket warhead apart from other ammunition.

3. Electrically fired rocket motors and electric or electronic fuzes shall not be stowed in the same compartment with, or be exposed within 5 feet of, any exposed electronic transmitting apparatus or exposed antenna leads. An exception can be made when the electronic apparatus or antenna is a part of the authorized test equipment of a weapon or is integral with a weapon containing such a rocket motor. In this event, the special instructions pertinent thereto shall apply.

4. Matches, naked lights, or any open flame is forbidden in the vicinity of rocket stowage.

5. Rockets containing pyrotechnic material, such as flares or an incendiary mixture, shall be stowed in regular pyrotechnic storage spaces, if such are provided, or in pyrotechnic lockers on upper decks.

6. Nothing shall be stowed in rocket ammunition magazines except rocket ammunition, its containers, and authorized magazine equipment. No oily rags, waste, or material susceptible to spontaneous combustion shall be stowed in these spaces.

7. Remove all rocket explosive components from a magazine before work which might cause an abnormally high temperature or an intense local heat is undertaken in the magazine.

8. Ready-service stowage of assembled rockets is authorized only for the 2.75-inch and 5.0-inch ZUNI folding-fin aircraft rockets. When the 2.75-inch rocket is shipped in the Aero 7D shipper-launcher-container, it may be stored as received, completely assembled. When partially ready rockets are required, in addition to ready-service stowage, unboxed rocket motors with fin assemblies attached should be stowed in below-deck magazines adjacent to bomb elevators. This stowage is authorized for rockets of the fixed-fin configuration instead of ready-service stowage. A separate locker may be provided for stowage of ready-service nose fuzes since these fuzes are not installed in warheads until the rockets are assembled and loaded on the launcher. This does not apply to the 2.75-inch folding-fin aircraft rocket; this warhead is stored with the fuze installed.

9. Rockets should be kept in the shade, away from direct sunlight, to avoid raising their propellent temperature above the prescribed safe limit.

Maintenance and Disposal

The Bureau of Naval Weapons Manual and other administrative directives specify the inspections and reports required on rockets in storage.

Repairs which are specifically permitted may be made by the ship or station using the ammunition. All other repairs may be made only by an ammunition depot. Components requiring these repairs must be turned in to a depot at the earliest opportunity.

Components in a hazardous condition should be disposed of by explosive ordnance disposal personnel. If such personnel is not available, the disposal will be performed as instructed by the officer in charge. Normally, this will mean lowering the item gently over the side in water at least 500 fathoms deep, 10 miles or more from shore.

Reports of any difficulties encountered with rocket components should be sent to the Bureau of Naval Weapons. The report should contain the lot number and history of the components involved. These reports will assist in the institution of measures to prevent recurrence of the difficulty.

Repairs Permitted Aboard Ship. For rocket heads, only the repainting, relettering, and removal of rust and corrosion are authorized.

For motors, only the repainting, relettering, removal of rust and corrosion, and repair of inert items are authorized. Fins, if dented or bent slightly, may be straightened with pliers, providing such action permits easy restoration of the original alinement. Check the straightened fin with a straight edge.

For fuzes, no shipboard repair or alteration is authorized.

Inspections. Inspection of components will be made as they are removed from containers for assembly or prior to their being placed in containers for return to stowage. Items found in a hazardous condition should be disposed of by explosive ordnance disposal personnel or, if none is available, as instructed by the officer in charge of the operation.

Turning in Components for Rework. At least 5 percent of the service allowance of rocket warheads assembled with base fuzes shall be turned in to the depot at the time of a general ammunition overhaul. The depot will examine the warheads for serviceability for continued stowage aboard ship.

The service allowance of rocket warheads shall be inspected by the commanding officer of the ammunition depot in company with the gunnery officer of the ship, or their representatives, prior to or during the period of the ammunition overhaul to determine what overhaul is required. If considered necessary, such warheads shall be turned in to the depot without further reference to the Bureau of Naval Weapons. Rocket warheads stowed aboard ship without base fuzes need not be turned in to the depot unless such action seems necessary after the inspection.

Rocket motors shall be turned in to an ammunition depot for reworking 5 years after the original assembly and every 3 years thereafter until replaced. Motors which have reached this age limit are still to be considered serviceable. However, they should be turned in for rework at the first opportunity, preferably during the ship's routine overhaul.

Shore-based rocket-using activities will report overage rocket motors on hand to the Bureau of Naval Weapons and request shipping instructions for their disposition. When turning in rocket motors which have been stored in temperatures above 100° F, the special records required for stowage in high temperatures should be turned in to the depot with the motors. Refer to the section on stowage in this chapter.

When rocket warheads are being turned in the nose fuzes issued for assembly in these warheads also should be turned in for inspection by the depot.

Items such as fins, tanks, and packing boxes shall be given a visual examination to determine their serviceability. Empty tanks and boxes, and all unserviceable fins shall be turned in to the depot. Replacement fins will be supplied when ammunition is reissued to the ship.

Marking and Identification

General. Rocket assemblies and components are painted, stamped, or tagged in accordance with Ordnance Specifications. Because of the different natures of rocket components, their identification systems are different. The methods of identification and the components to which they apply are described in the following paragraphs.

Nomenclature. Where special rules do not apply, a rocket component is classified by its generic term, followed by its mark and mod designation; for example, Igniter Mk 120 Mod 2. For heads, motors, and complete rounds, there are special rules. The nomenclature consists of information combined in the following sequence.

1. Heads.
   a. Caliber.
   b. The words "Rocket Head."
   c. Mark and mod of the inert parts, considered as a unit.
   d. Parenthetical descriptive term describing the load in the head, such as (GP), (VT), or (PRAC).

A typical example is a 5.0-Inch Rocket Warhead Mk 6 Mod 4 (VT). The mark and mod designation of the head does not change with a change in the load of the head; only the parenthetical term changes.

2. Motors.
   a. Caliber.
   b. The words "Rocket Motor."
   c. Mark and mod of the loaded motor.

A typical example is 5.0-Inch Rocket Motor Mk 10 Mod 6. The mark and mod of the loaded motor may not necessarily be the same mark and mod as the inert parts. In the first motor of a series, this mark and

mod usually will be the same, but if the igniter, propellent grain, electrical connector, or some other component is changed, a new mark or mod designation will be assigned.

3. Complete rounds.

a. Caliber (of the head if there is a difference in caliber between the head and the motor).

b. The word "Rocket."

c. Mark and mod of the complete assembly.

d. Parenthetical phrase including the type of head, such as (AP) or (SC), followed by AR for aircraft rockets. Rockets used in antisubmarine warfare are designated as ASW.

Typical examples are 2.25-Inch Rocket Mk 4 Mod 0 (SCAR) and 5.0-Inch Rocket Mk 34 Mod 0 (AP/ASW, HVAR).

Mark and Mod. These designations are assigned rocket components on the same basis as that for other Navy ordnance. The practice for heads and motors has already been discussed. For complete rocket assemblies, the following rules apply.

1. The mark number changes when the new design falls into one of the following categories.

a. It is dimensionally different or noninterchangeable to the extent that it cannot be fired from the same launcher.

b. It is different in its exterior ballistics.

c. It has a different load in its head; for example, the head load is changed from general purpose (GP) to practice (PRAC).

2. The mod number changes when one of the following takes place.

a. The fuze(s) is changed.

b. The dimensions are not changed enough to require a different launcher, but enough to require different stowage or handling equipment.

c. The chemical nature of the head filling is changed (not the type of filling but its actual substance); for example, the smoke mixture in a head is changed from FS to PWP.

Drawing Numbers. Components which are not of enough importance or which are not separate in their nature are not assigned mark and mod numbers. They are designated by their drawing number.

Color Coding. Rocket heads, motors, and accessories are painted different colors to distinguish types. Fuzes are not painted, while fin assemblies are painted the same color as the motor. The following coding is used:

COLOR	ITEM
Olive drab	All service warheads not loaded with a chemical, incendiary, or special filler.
Ocean gray	Warheads loaded with a chemical or special filler.
Black	Dummy or inert-loaded heads.
Light blue	Practice heads.
One yellow band on rear of the head	Smoke-filled warheads.
Blue gray	All service motors.
Black	Dummy or inert-loaded motors.
White	Mk 15 Mod 0 and Mk 17 Mod 0 Rocket Motors used with guided missiles and unguided target rockets.

Lot Numbers. The ammunition lot system provides a means by which records may be maintained of the components assembled. The ammunition lot serves as a unit by which defective components may be restricted from issue or from service use. The lot number also is a unit for stowage and shipping.

Each ammunition lot is assigned a number consisting of three parts—the prefix designation, the numerical group, and the suffix. A typical lot number is RHDF–1764–HAW–45.

The first letter "R" of the prefix designation indicates rocket ammunition. The second letter indicates the rocket unit. In this example, "H" indicates head. "M"

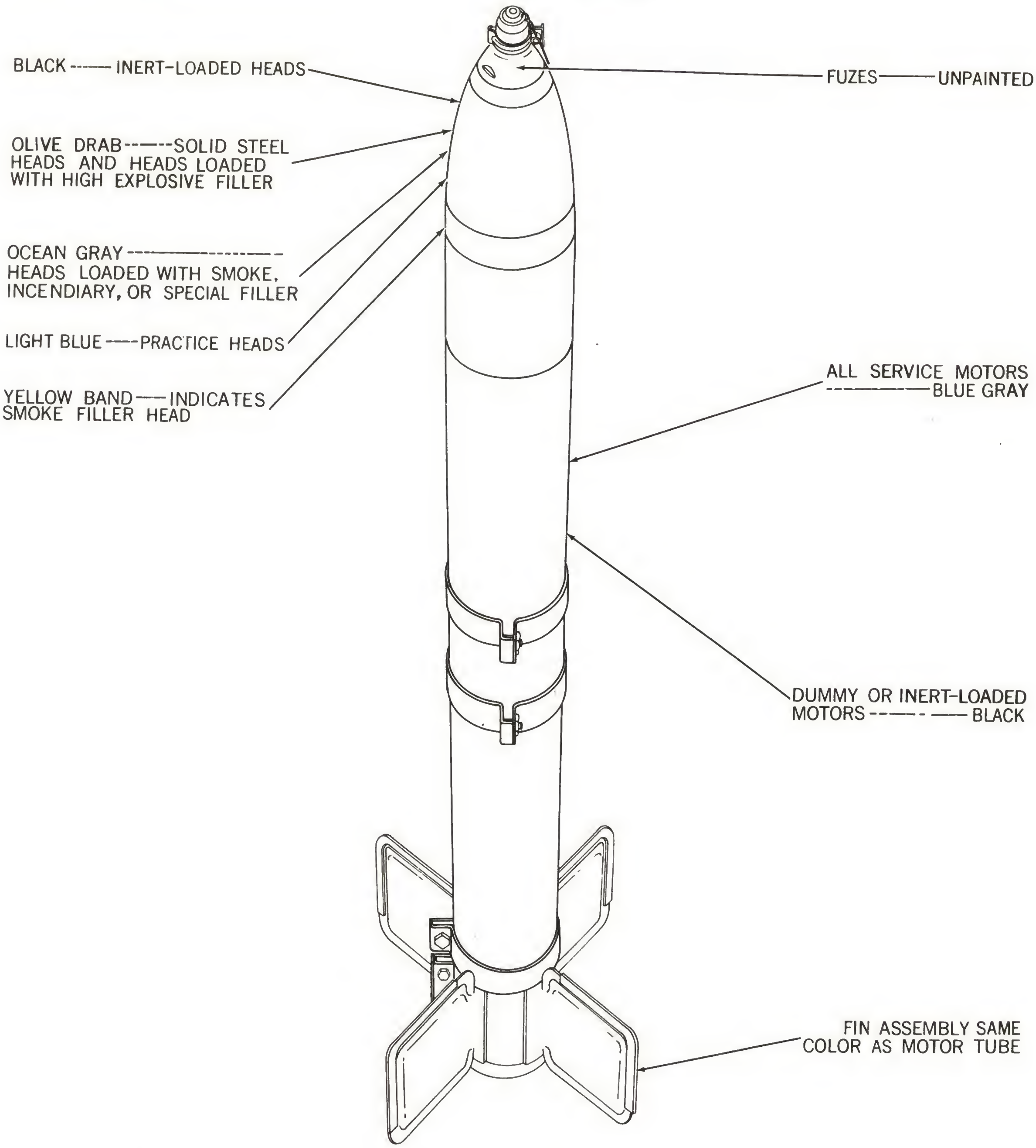


Figure 1–29. Color Code for Rockets.

would indicate motor, and "T" would indicate a head and a motor packed unassembled in a single container. The third letter (A to Z) and fourth letter (A to Z) are assigned from a list of rocket assemblies to designate the caliber and type of load, respectively. Examples are:

1. RHDF—7.2-inch HE rocket warhead with HBX–1 explosive filler.

2. RTCD—2.75-inch HEAT rocket with

an RHHC rocket warhead (composition B filler) and an RMHA rocket motor.

The numerical group is one of a consecutive series of numbers assigned under each prefix designation by a particular ammunition loading activity. Each numerical group begins with number one (1) for the first lot loaded under each prefix designation in the year of 1945 and continues consecutively ad infinitum.

The suffix consists of a code group assigned to identify each loading activity and the year of assembly. In the example, "HAW" represents Naval Ammunition depot, Hawthorne, Nevada.

A complete reading of the legend "RHDF–1764–HAW–45" is "the 1764th lot of 7.2-inch rocket warhead (HE) loaded with HBX–1 explosive filler at Hawthorne. This lot was assembled in 1945."

Marking. Rocket heads, motors, and fuzes are identified by legends which may be stenciled, rubber stamped, or indent stamped on their exterior. Rocket heads have four legends, motors have three, and fuzes one. Following are descriptions of each of the legends.

1. MANUFACTURER'S IDENTIFYING LEGEND. This is indent stamped by the metal parts manufacturer on each head and motor. It contains the following information.

a. The first line contains the nominal caliber in inches; the word "HEAD" or "MOTOR," as applicable; and the applicable mark and mod number.

b. The second line bears the Bureau of Naval Weapons drawing number.

c. The third line contains the contract number and the contractor's lot number.

d. The fourth line bears the contractor's initials or identifying symbol, and the Department of Defense inspector's stamp (eagle) or Navy inspector's stamp (anchor) indicating acceptance of an item.

2. MANUFACTURER'S CODE SYMBOL. This is indent stamped by the inert metal parts manufacturer on each head and motor. It contains the following information:

a. Applicable mark and mod numbers.

b. The code number designating the type of inert parts assembly as follows:

ASSEMBLY	CODE NUMBER
Rocket head	3
Rocket motor	4

c. The letter symbol assigned by the Bureau of Naval Weapons to each manufacturer which applies to all inert parts assemblies of any one type.

d. The same lot number used in the manufacturer's identifying legend.

A typical manufacturer's code symbol might be "Mk 17–2 Lot 4A157." This would mean Lot No. 157 of Rocket Motor Mk 17 Mod 2 manufactured by a contractor identified by the letter A.

3. HEAD LEGEND (FIRST). The following legend is placed by the loading activity on the head only. It is located 120° from the manufacturer's identifying legend.

a. The type of filler, such as WP-SMOKE or CAST TNT; and the weight of the filler to the nearest tenth of a pound.

b. Navy ammunition lot number.

c. Navy ammunition code number.

d. Mark and mod number of the base detonating fuze. This is omitted when no such fuze is installed.

4. HEAD LEGEND (SECOND). The following legend also is placed by the loading activity on the head only. It is located 240° from the manufacturer's identifying legend. It consists of one of the following to indicate the type of load: HE, GP, SOLID, FLARE, INERT, or SM.

5. MOTOR LEGEND. The following legend is placed only on the motor by the loading activity. It is located 180° from the manufacturer's identifying legend on the motor.

a. Propellent grain mark and mod number; and propellent grain lot number, which indicates the grain extrusion activity followed by the lot number. For example, "NPF 21" means Lot No. 21 from the Naval Powder Factory.

b. Navy ammunition lot number.

c. Navy motor code number.

d. Motor temperature limits.

6. FUZE LEGEND. The following legend is usually indent stamped on the fuze. The arrangement of its data may vary to conform to the shape of the fuze. The legend will contain the following information:

a. Letters indicating the type of fuze, such as "NF," or "BDF."

b. The mark and mod.

c. The manufacturer's initials or symbol.

d. The lot number.

e. The initials or symbol of the loading activity.

f. The month and year of loading.

g. Department of Defense inspector's stamp (eagle) or Navy inspector's stamp (anchor).

7. PROPELLENT GRAIN LEGEND. This is rubber stamped or indent stamped, and includes the manufacturer's initials, lot number, and mark and mod.

8. IGNITER LEGEND. Either stamped or stenciled, this legend includes the term "igniter," mark and mod, lot number, loading depot symbol, and date of loading (month and year).

9. AUXILIARY BOOSTER LEGEND. This is either rubber stamped on the booster or printed on a label attached to the booster. The legend consists of the term "auxiliary booster," mark and mod, weight (in grams), the explosive filler, lot number, place of loading, date of loading (month and year), and the inspector's initials.

10. ELECTRIC CONNECTOR LEGEND. This is stamped on a cable clamp or a cable marking tape. The legend consists of the mark and mod only.

Data Cards. Data cards are made for each ammunition lot of rockets and components, listing such information as caliber, quantity, contract number, container dimension, contents, components, mark and mod, nose fuze thread diameter, note as to use with other components of round, propellent grain loading, and reference to pertinent Ordnance Pamphlets. This information is necessary in making out defective ammunition reports. One copy of the data card is included in each shipping container.

General Safety Precautions

The general precautions follow. Specific regulations are found in other portions of this publication where they apply.

1. The Bureau of Naval Weapons shall be informed of any circumstances which conflict with the safety precautions or which, for any reason, require changes in or additions to them.

2. When in doubt as to the exact meaning of a safety precaution, an interpretation shall be requested from the Bureau of Naval Weapons.

3. Do not make changes in or additions to rocket material without explicit authority from the Bureau of Naval Weapons. Authorized assemblies are shown in OP 1415.

4. No ammunition or explosive assembly shall be used in any rocket launcher for which it is not designated.

5. No ammunition other than dummy-drill shall be used for drill.

Chapter 2

ROCKET HEADS

2.25-INCH ROCKET HEAD MK 3 MODS 0, 2, AND 3 (PRAC, SC)

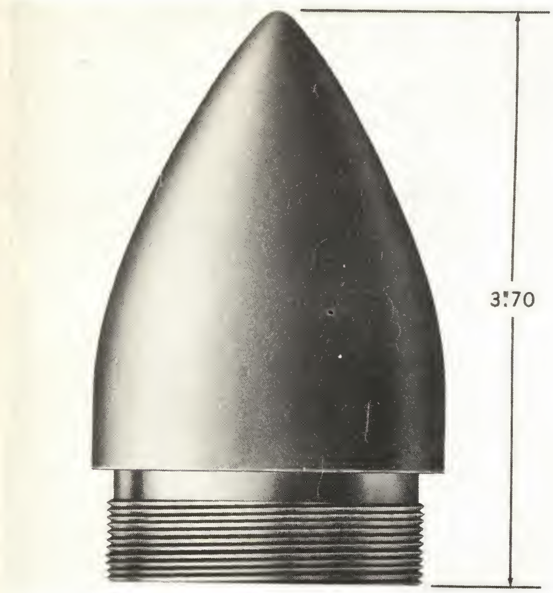


Figure 2–1. 2.25-Inch Rocket Head Mk 3 Mod 3 (PRAC, SC), External View.

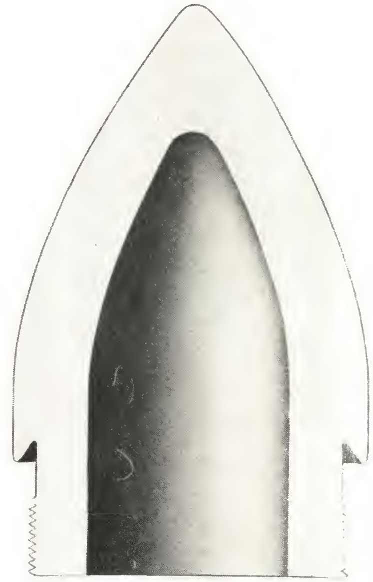


Figure 2–2. 2.25-Inch Rocket Head Mk 3 Mod 3 (PRAC, SC), Cross Section.

Mark	3	3	3
Mod	0	2	3
Lot No. Prefix	None	None	None
List of Drawings	None	175447	None
Loading Assembly No.	424977	439208	439490
Overall Shipping Length (in.)	3.75	3.75	3.70
Length without Details (in.)	3.75	3.75	3.70
Nominal Weight Shipped (lb)	1.60	1.60	1.60
Nominal Weight Fired (lb)	1.60	1.60	1.60
Filler	None	Plaster	None
Container Mk-Mod	2–0	2–0	2–0

Special Information

These heads are for the practice, subcaliber rounds which simulate the trajectory of the 5.0-inch high-velocity rockets.

Mod 0 is made of steel. It has no undercut at the after end of the ogive such as is found on the Mods 2 and 3. The Mod 2 is made of zinc. This head also is assembled in dummy rounds. The Mod 3 is made of cast iron.

2.75-INCH ROCKET HEAD MK 1 MODS 1, 3, 4 AND 5 (HE or PRAC)

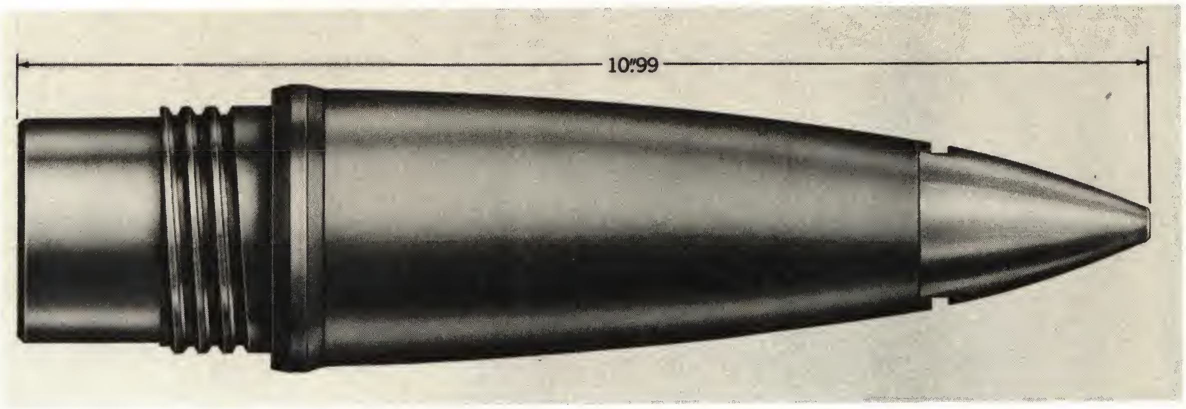


Figure 2–3. 2.75-Inch Rocket Head Mk 1 Mod 5 (HE or PRAC), External View.

Mark	1	1	1	1
Mod	1	3	4	5
Lot No. Prefix:				
HE	RHHA	RHHA	RHHA	RHHA
PRAC	RHHB	RHHB	RHHB	RHHB
List of Drawings	174702	174806	255945	255946
Loading Assembly No.	656227	656227	656227	656227
Overall Shipping Length (in.)	10.99	10.99	10.99	10.99
Nominal Weight (lb)	6.47	6.47	6.47	6.47
Filler:				
Type:				
HE	HBX–1	HBX–1	HBX–1	HBX–1
PRAC	Inert	Inert	Inert	Inert
Weight	1.40	1.40	1.40	1.40

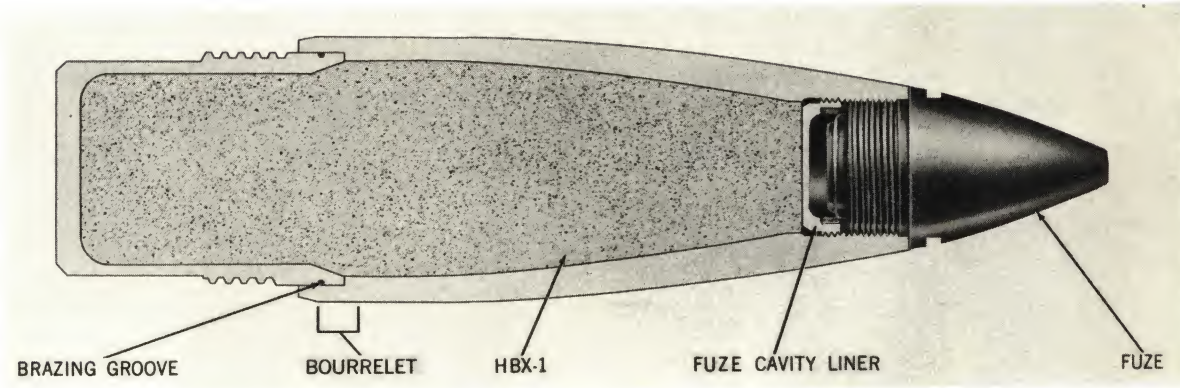


Figure 2–4. 2.75-Inch Rocket Warhead Mk 1 Mod 5 (HE), Sectional View.

Special Information

The differences in the mods of this head are as follows.

1. Mod 1 is of one-piece, forged construction and has no fuze cavity liner.
2. Mod 3 is cold-formed and has no fuze cavity liner.
3. Mod 4 is made of two pieces brazed together (near the bourrelet). It has a fuze cavity liner.
4. Mod 5 is similar to the Mod 4, except that the base is formed by stamping instead of forging.

Any of these mods may be loaded with an inert filler instead of HBX–1 to become a practice head. A steel nose plug is assembled in practice heads in place of the nose fuze. Inert loaded heads do not require fuze cavity liners, although some do have them.

2.75-INCH ROCKET WARHEAD MK 5 MOD 0 (HEAT)

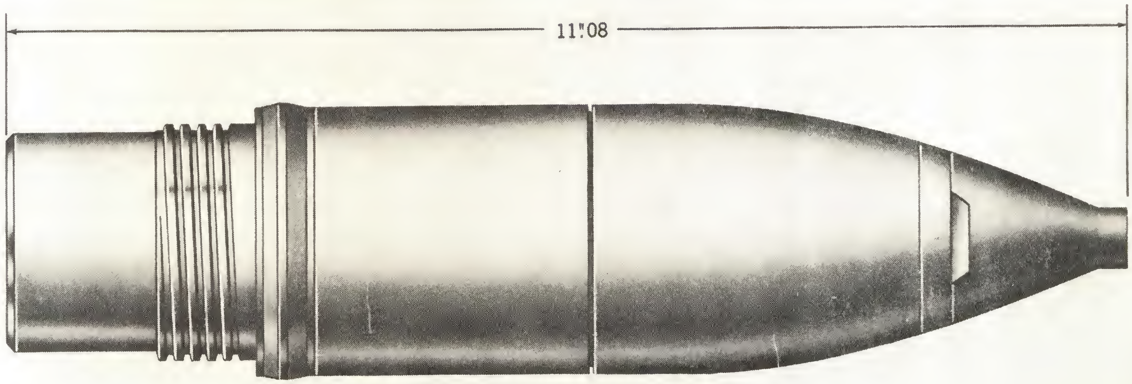


Figure 2–5. 2.75-Inch Rocket Warhead Mk 5 Mod 0 (HEAT), External View.

Mark	5
Mod	0
Lot No. Prefix	RHHC
List of Drawings	256096
Loading Assembly No.	1350663
Overall Shipping Length (in.)	11.08
Nominal Weight (lb)	6.60
Filler:	
Type	Comp. B
Weight (lb)	0.89
Booster:	
Type	Tetryl
Weight (gm)	13.8

Special Information

Unlike the earlier shaped-charge warhead for aircraft rockets, this warhead employs no detonating cord to transmit the explosive impulse of the nose fuze to the main filler. The shaped-charge booster in the nose fuze propels an explosive jet through the cone and flash tube unassisted to the booster pellet, which then detonates the main filler. There are relatively few fragments of the warhead scattered in the explosion; these are in a narrow cone of dispersion.

5.0-INCH ROCKET WARHEAD MK 2 MOD 2 (AP)

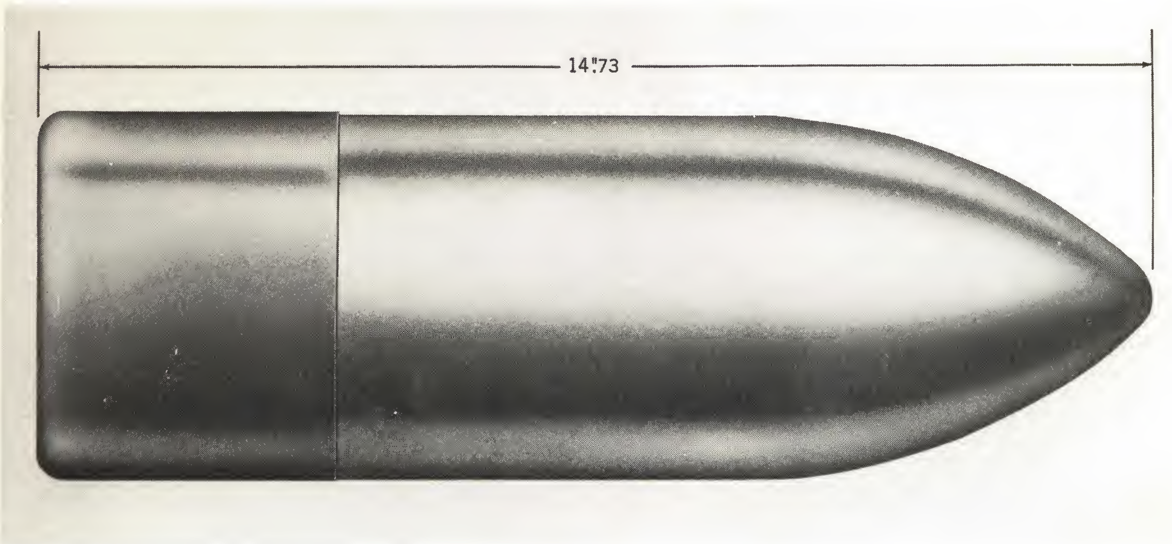


Figure 2–6. 5.0-Inch Rocket Warhead Mk 2 Mod 2 (AP), External View.

Mark	2	Nominal Weight Shipped (lb)	51.98
Mod	2	Nominal Weight Fired (lb)	48.30
Lot No. Prefix	RHCQ	Filler:	
List of Drawings	165464	Type	Exp D
Loading Assembly No.	562638	Weight (lb)	2.2
Overall Shipping Length (in.)	14.73	Base Fuze Mk-Mod	166–0 or 2
Length without Details (in.)	13.63	Container Mk-Mod	22–0

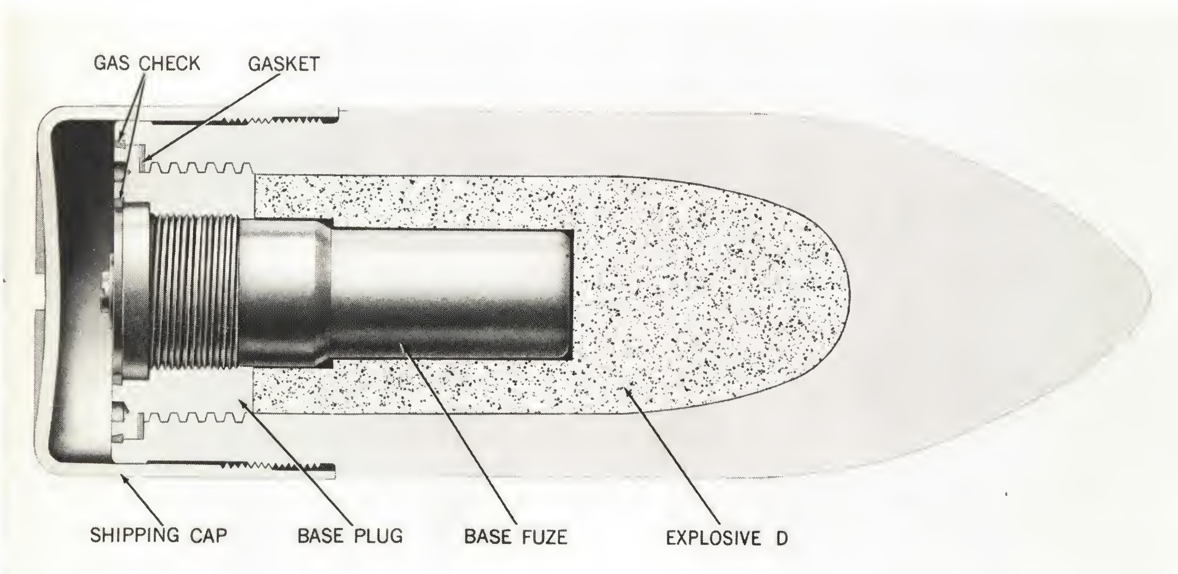


Figure 2–7. 5.0-Inch Rocket Warhead Mk 2 Mod 2 (AP), Cross Section.

5.0-INCH ROCKET WARHEAD MK 4 MOD 1 (SMOKE-PWP)

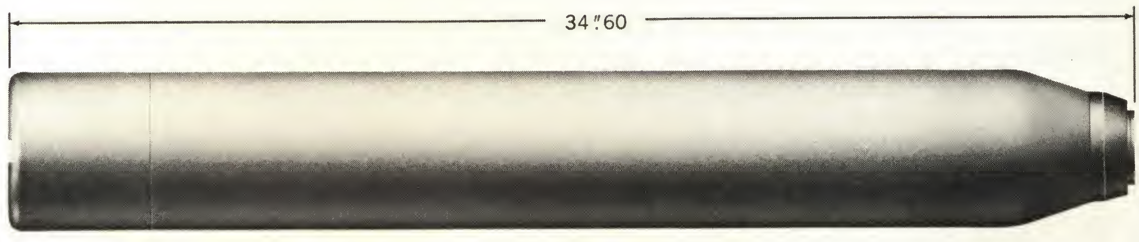


Figure 2–8. 5.0-Inch Rocket Warhead Mk 4 Mod 1 (SMOKE-PWP), External View.

Mark	4
Mod	1
Lot No. Prefix	RHCG
List of Drawings	174830
Loading Assembly No.	656341
Overall Shipping Length (in.)	34.60
Length without Details (in.)	33.28
Nominal Weight Shipped (lb)	52.00
Nominal Weight Fired (lb) (Without Nose Fuze)	48.09
Filler:	
Type	PWP
Weight (lb)	19.36
Burster Charge:	
Type	Tetryl
Weight (gm) (approx)	135
Container Mk-Mod	15–1

Special Information

This smoke warhead is designed for pin-pointing surface targets or for filling gaps in smoke screens.

The burster tube is assembled at the loading activity.

5.0-INCH ROCKET WARHEAD MK 6 MOD 1 (HE) AND MOD 4 (VT)

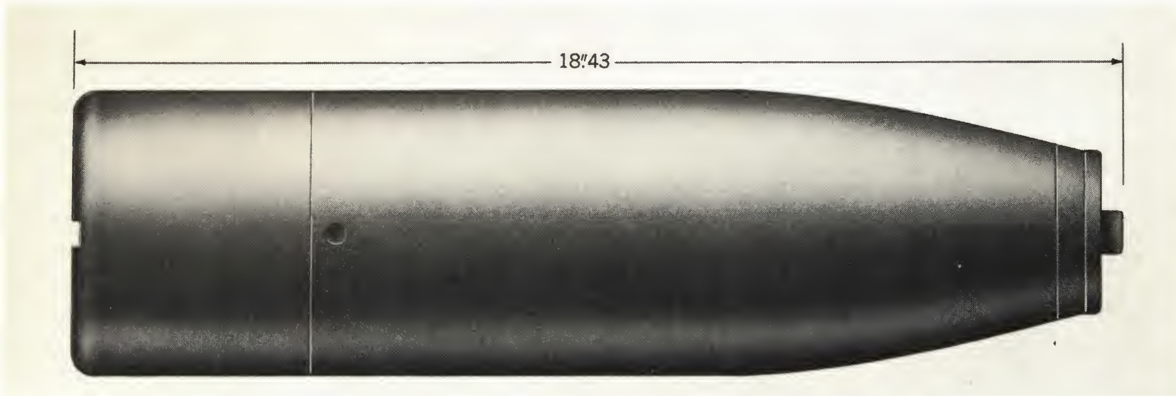


Figure 2–9. 5.0-Inch Rocket Warhead Mk 6 Mod 4 (VT), External View.

Warhead Type	HE	VT
Mark	6	6
Mod	1	4
Lot No. Prefix	RHCJ	RHCY
List of Drawings	165018	174569
Loading Assembly No.	561527	655874
Overall Shipping Length (in.)	18.30	18.43
Length without Details (in.)	16.45	16.45
Nominal Weight Shipped (lb)	50.55	49.89
Nominal Weight Fired (lb) (Without Nose Fuze)	45.87	45.04
Filler:		
Type	TNT	TNT
Weight (lb)	7.60	7.10
Booster:		
Mk-Mod	3–1	None
Number Required	1	None
Nose Fuze Mk-Mod	149–0 or 1	172–2 (VT)
Base Fuze Mk-Mod	164–0	164–0
Container Mk-Mod	12–0	12–0
Pallet Adapter Mk-Mod	11–1	11–1
Pallet Unit Load	1341931	1341931
Lot No. Prefix (Practice Head)	RHCI	RHCI

Special Information

The principal difference between the mods of this warhead is the special cavity of the Mod 4 which is designed to receive a VT fuze.

When the Mod 1 is fuzed with Nose Fuze Mk 149, theoretically this head should make a 5-inch hole in 1½-inch armor. Against armor of this thickness, there will be only a small number of fragments behind the plate. With the nose fuze made inoperative, so that detonation will be initiated by the short-delay base fuze, this warhead should penetrate 1-inch armor and explode with

maximum effectiveness a few feet behind the plate.

Against reinforced concrete (5000 psi), this warhead is capable of penetrating 3.75-inch slabs at normal obliquity and 2.75-inch slabs at 30° obliquity. The nose fuze should be set on SAFE against concrete, so that detonation will be initiated by the short-delay base fuze.

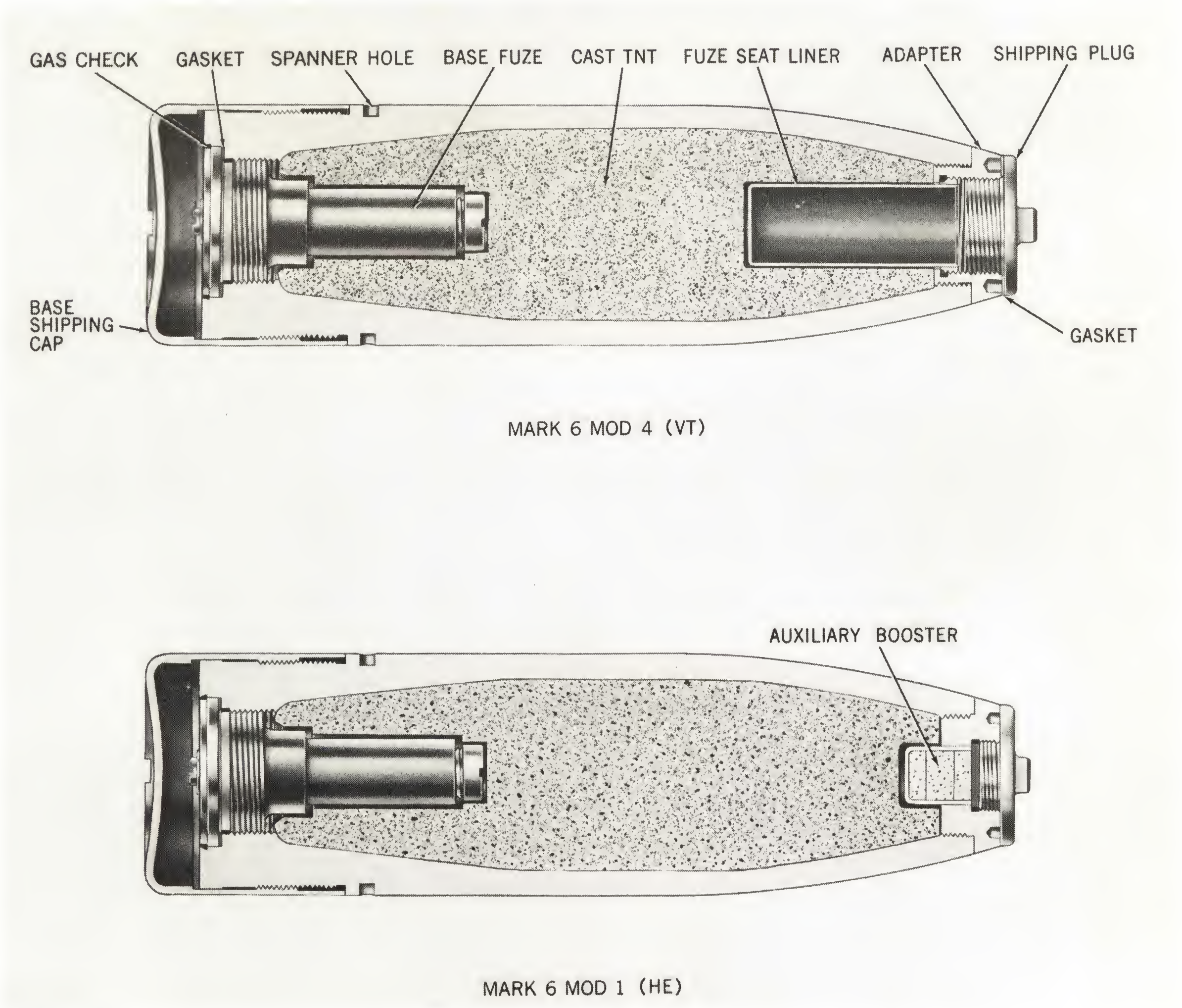


Figure 2–10. 5.0-Inch Rocket Warheads Mk 6 Mod 4 (VT) and Mk 6 Mod 1 (HE), Cross Sections.

5.0-INCH ROCKET WARHEAD MK 24 MOD 0 (HE)

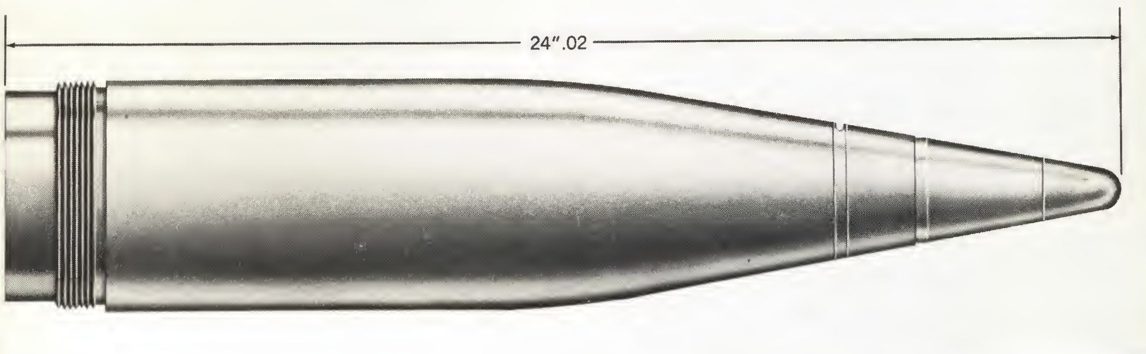


Figure 2–11. 5.0-Inch Rocket Warhead Mk 24 Mod 0, External View.

Warhead Type	PD	VT
Mark	24	24
Mod	0	0
Lot No. Prefix	RHZA	RHZB
List of Drawings	174919	174919
Loading Assembly No.	656560	656560
Overall Shipping Length (in.) (approx)	19.31	19.31
Length without Details (in.)	17.850	17.850
Nominal Weight Shipped (lb)	50.12	50.12
Nominal Weight Fired (lb) (approx)	48.00	48.00
Filler:		
Type	Comp B	Comp B
Weight (lb)	9.50	9.50
Nose Fuze Mk-Mod	188–0	T2061
Nose Ogive	Nots Dwg. 458162 Ogive, Nose	
Base Fuze Mk-Mod	191–0	191–0
Container Mk-Mod	39–0	39–0

Special Information

This warhead was designed primarily for use with the 5.0-inch folding-fin aircraft rocket (ZUNI) and fulfills a variety of tactical needs. The warhead produces fragments and may be fuzed for contact, influence, or delayed detonation. Built into the warhead is a base fuze that is used in conjunction with the Mk 188 PD or the T2061 nose fuze or with a steel ogive nose plug. The steel ogive enables the head to penetrate heavy targets, such as concrete buildings or surface vessels, and to detonate inside.

5.0-INCH ROCKET WARHEAD MK 25 MODS 1 AND 2 (HEAT)

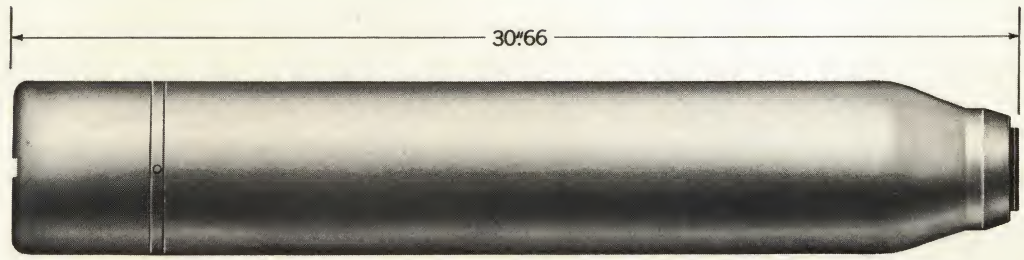


Figure 2–12. 5.0-Inch Rocket Warhead Mk 25 Mod 2 (HEAT) External View.

Mark	25	25
Mod	1	2
Lot No. Prefix	RHCZ	RHCZ
List of Drawings	255540	268469
Loading Assembly No.	563481	656784
Overall Shipping Length (in.)	30.66	30.66
Length without Details (in.)	29.16	29.16
Nominal Weight Shipped (lb)	51.65	51.65
Nominal Weight Fired (lb) (Without Nose Fuze)	47.85	47.85
Filler:		
Type	Comp B	Comp B
Weight (lb)	15.33	15.33
Initiator:		
Type	Tetryl	Tetryl
Weight (gm) (approx)	1.71	1.71
Booster:		
Type	Tetryl	Tetryl
Weight (gm) (approx)	126	126
Nose Fuze Mk-Mod	149–0 or 1	149–0 or 1
Container Mk-Mod	27–0	27–0
Pallet Adapter Mk-Mod	11–1	11–1
Pallet Unit Load	1341931	1341931

Special Information

This warhead was developed primarily for use against tanks.

Because of the thin wall and relatively large explosive charge, fragments from the warhead are projected at extremely high velocities. Although the fragments are somewhat smaller than those from a general purpose warhead, they are much more numerous.

During proving ground tests, Warhead Mk 25 gave three times as many fragment perforations of ⅛-inch mild steel and two times as many perforations of ⅜-inch mild steel at 30 feet, compared to General Purpose Warhead Mk 6. Also, the blast effect of this warhead is appreciably greater than that of the GP warhead.

However, it should be remembered that, with the shaped-charge warhead, detonation always occurs outside of the target. Any damage behind a heavy target will be as a result of the narrow, high-velocity, high-temperature jet from the shaped charge.

The Mod 2 differs from the Mod 1 principally in the construction of the adapter. The Mod 1 adapter is brazed directly onto the nose assembly. The Mod 2 adapter is threaded to a ring, which is brazed onto the nose assembly.

This warhead is assembled in the same manner as most of the other 5.0-inch warheads. In fuzing the warhead, no attempt should be made to remove the initiator case lockring at the bottom of the fuze cavity. Care should also be taken to avoid striking the aluminum cap under the lockring, since the initiator is beneath this cap.

5.0-INCH ROCKET WARHEAD MK 29 MOD 0 (AP/ASW)

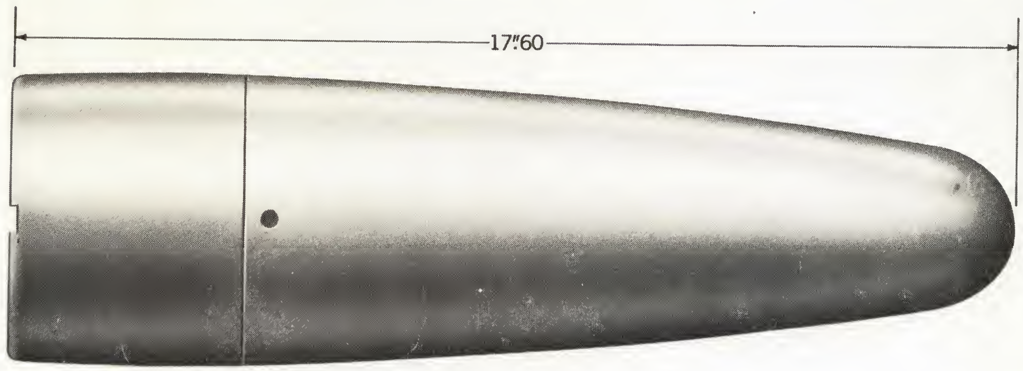


Figure 2–13. 5.0-Inch Rocket Warhead Mk 29 Mod 0 (AP/ASW), External View.

Mark	29
Mod	0
Lot No. Prefix	RHKA
List of Drawings	174796
Loading Assembly No.	656404
Overall Shipping Length (in.)	17.60
Length without Details (in.)	16.50
Nominal Weight Shipped (lb)	52.24
Nominal Weight Fired (lb)	48.56
Filler:	
Type	Exp D
Weight (lb)	3.03
Base Fuze Mk-Mod	Plugged
Container Mk-Mod	32–0

Special Information

This armor-piercing warhead is designed for use against submarines and other underwater targets. Not all Mk 29 warheads carry explosive charges, however; some are base plugged.

Because Base Fuze Mk 166 caused the round to detonate outside the target, this fuze has been replaced by a base fuze hole plug. The plugged configuration of the Mk 29 warhead assures penetration, although the round will not detonate; this penetration, however, is sufficient to "kill" a submarine. The plugged Mk 29 contains an explosive charge; it is not an inert head, and SHALL NOT be used for drill purposes.

5.0-INCH ROCKET WARHEAD MK 32 MOD 0 (ATAP)

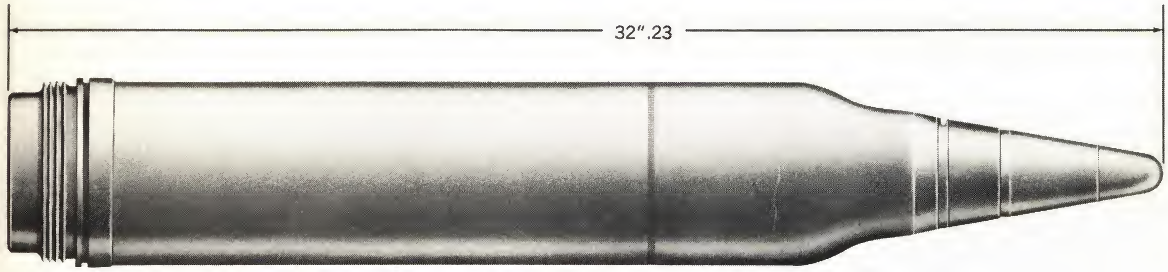


Figure 2–14. 5.0-Inch Rocket Warhead Mk 32 Mod 0 (ATAP), External View.

Warhead Type	HE	VT
Mark	32	32
Mod	0	0
Lot No. Prefix	RH2C	RH2D
List of Drawings	268535	268535
Loading Assembly No.	656891	656891
Overall Shipping Length (in.)	30.299	30.299
Length without Details (in.) (approx)	29.112	29.112
Nominal Weight Shipped (lb)	46.16	46.16
Nominal Weight Fired (lb)	45.76	45.76
Filler:		
Type	Comp B	Comp B
Weight (lb)	15.00	15.00
Initiator-Booster Assembly:		
Type	Tetryl	Tetryl
Weight (lb)	.30	.30
Nose Fuze Mk-Mod	188–0	T2061
Container Mk-Mod	31–0	31–1

Special Information

The Rocket Warhead Mk 32 Mod 0, designed primarily for use with the 5.0-inch folding-fin aircraft rocket (ZUNI), is equally effective against heavy ground or surface targets. For shaped-charge action against heavily armored targets, the warhead is fitted with a point-detonating nose fuze. A 1/8-inch-thick copper cone inside the warhead produces the shaped jet. Using an influence-detonating nose fuze for fragmentation action against aircraft, the Warhead Mk 32 produces a destructive envelope of high-speed fragments. Fragmentation is controlled by a waffled plastic liner next to the steel warhead shell.

Chapter 3

ROCKET MOTORS

2.25-INCH ROCKET MOTOR MK 15 MODS 0 AND 2

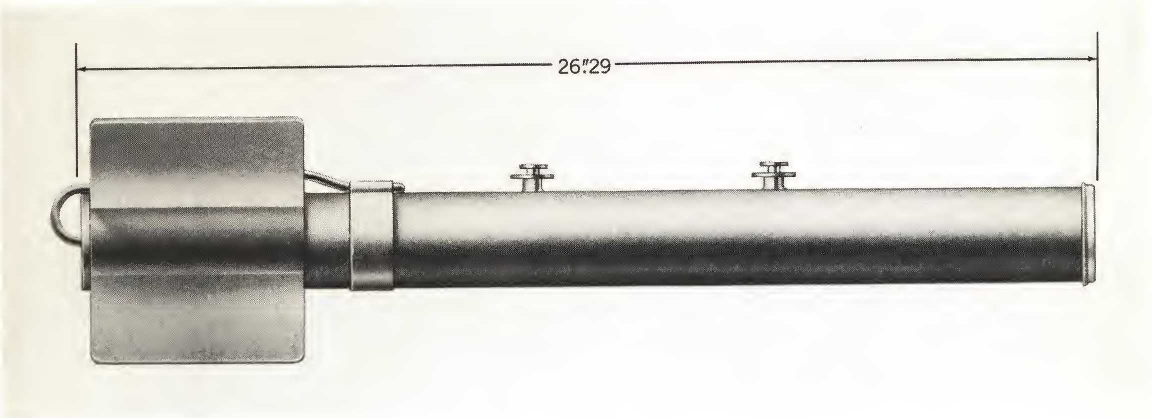


Figure 3–1. 2.25-Inch Rocket Motor Mk 15 Mod 2, External View.

Mark	15	15
Mod	0	2
Loading Assembly No.	656221	656222
List of Drawings	174694	174695
Lot No. Prefix	RMBF	RMBF
Type Stabilization	Fin	Fin
Nominal Weight Shipped (lb)	10.90	10.90
Nominal Weight Fired (lb)	10.87	10.87
Thrust (lb)	710	710
Overall Shipping Length (in.)	26.29	26.29
Length without Details (in.)	26.19	26.19
Fin Diameter (in.)	8.30	8.30
Distance between Lugs (in.)	6.0	6.0
Burning Time (sec.)	0.54	0.54
Propellent Grain Mk-Mod	16–1	16–1
Igniter Mk-Mod	112–0, 1, or 2	112–0, 1, or 2
Electrical Connector:		
Mk-Mod	12–2	12–2
Length of Cable (in.)	30.5	30.5
Container Mk-Mod	2–0	2–0

Special Information

The Mod 0 motor tube is seamless and the Mod 2 motor tube is electrically welded.

The two lower fins, those farthest from the suspension buttons, each have two slits near their inboard trailing edge. The metal between these 1-inch-long slits is bent over the cable of the electrical connector to secure the cable to the rocket. Securing the cable to the rocket in this fashion prevents the nozzle-closure end of the cable from striking the wing of the plane when the rocket is fired.

Refer to the assembly procedure for this rocket in chapter 6.

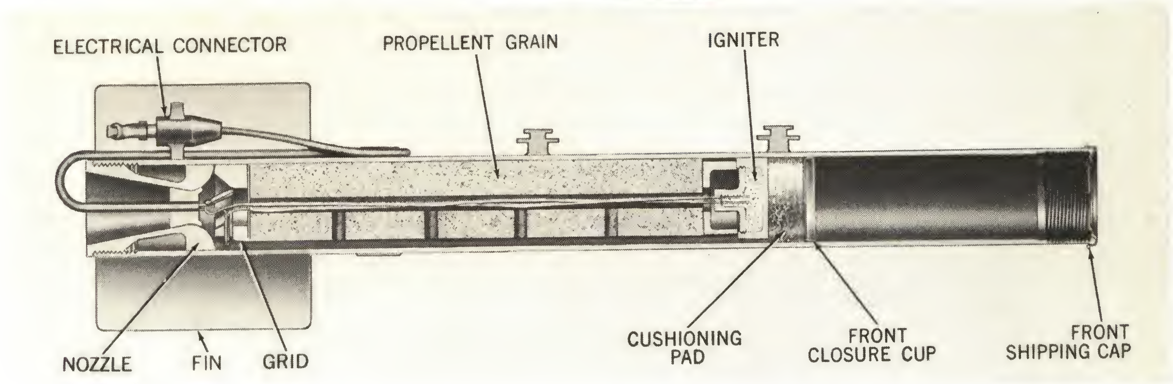


Figure 3–2. 2.25-Inch Rocket Motor Mk 15 Mod 2, Cross Section.

2.25-INCH ROCKET MOTOR MK 16 MODS 4 AND 6

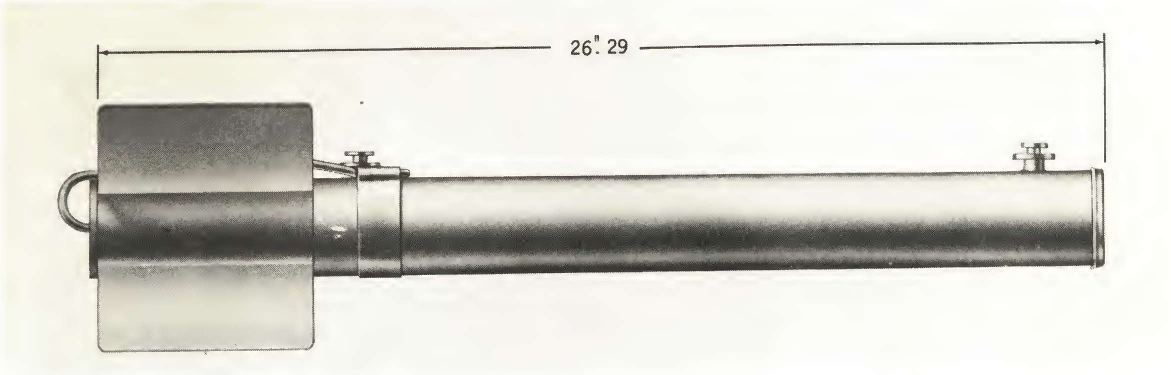


Figure 3–3. 2.25-Inch Rocket Motor Mk 16 Mod 6, External View.

Mark	16	16
Mod	4	6
Loading Assembly No.	656767	656832
List of Drawings	268477	268483
Lot No. Prefix	RMBF	RMBF
Type Stabilization	Fin	Fin
Nominal Weight Shipped (lb)	10.89	10.89
Nominal Weight Fired (lb)	10.86	10.86
Thrust (lb)	710	710
Overall Shipping Length (in.)	26.29	26.29
Length without Details (in.)	26.19	26.19
Fin Diameter (in.)	8.30	8.30
Distance between Lugs (in.)	18.50	18.50
Burning Time (sec.)	0.54	0.54
Propellent Grain Mk-Mod	16–1	16–1
Igniter Mk-Mod	112–0, 1, or 2	112–0, 1, or 2
Electrical Connector:		
Mk-Mod	10–4	10–4
Length of Cable (in.)	18.65	18.65
Container Mk-Mod	2–0	2–0

Special Information

The motor tube of the Mod 4 is seamless and the motor tube of the Mod 6 is electrically welded.

The two lower fins, those farthest from the suspension buttons, each have two slits near their inboard trailing edge. The metal between these 1-inch-long slits is bent over the cable of the electrical connector to secure the cable to the rocket. Securing the cable to the rocket in this fashion prevents the nozzle-closure end of the cable from striking the wing of the plane when the rocket is fired.

Refer to the assembly procedure for this rocket in chapter 6.

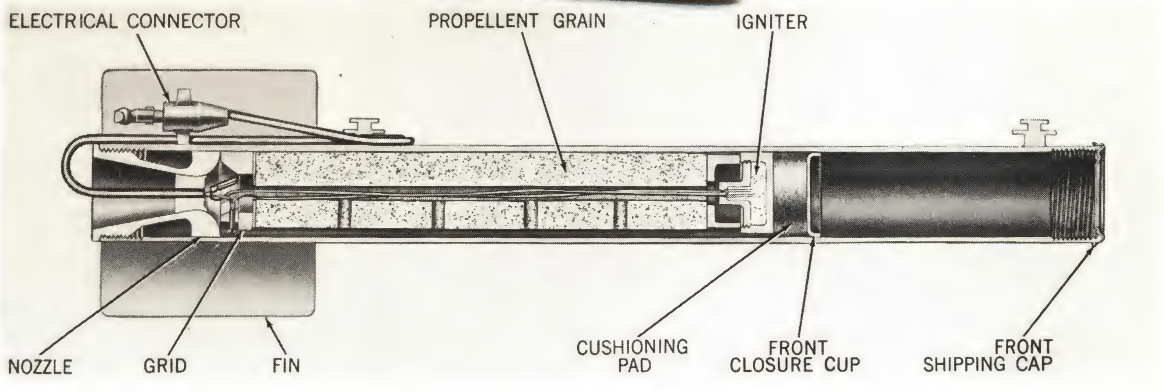


Figure 3–4. 2.25-Inch Rocket Motor Mk 16 Mod 6, Cross Section.

2.75-INCH FOLDING-FIN AIRCRAFT ROCKET MOTORS

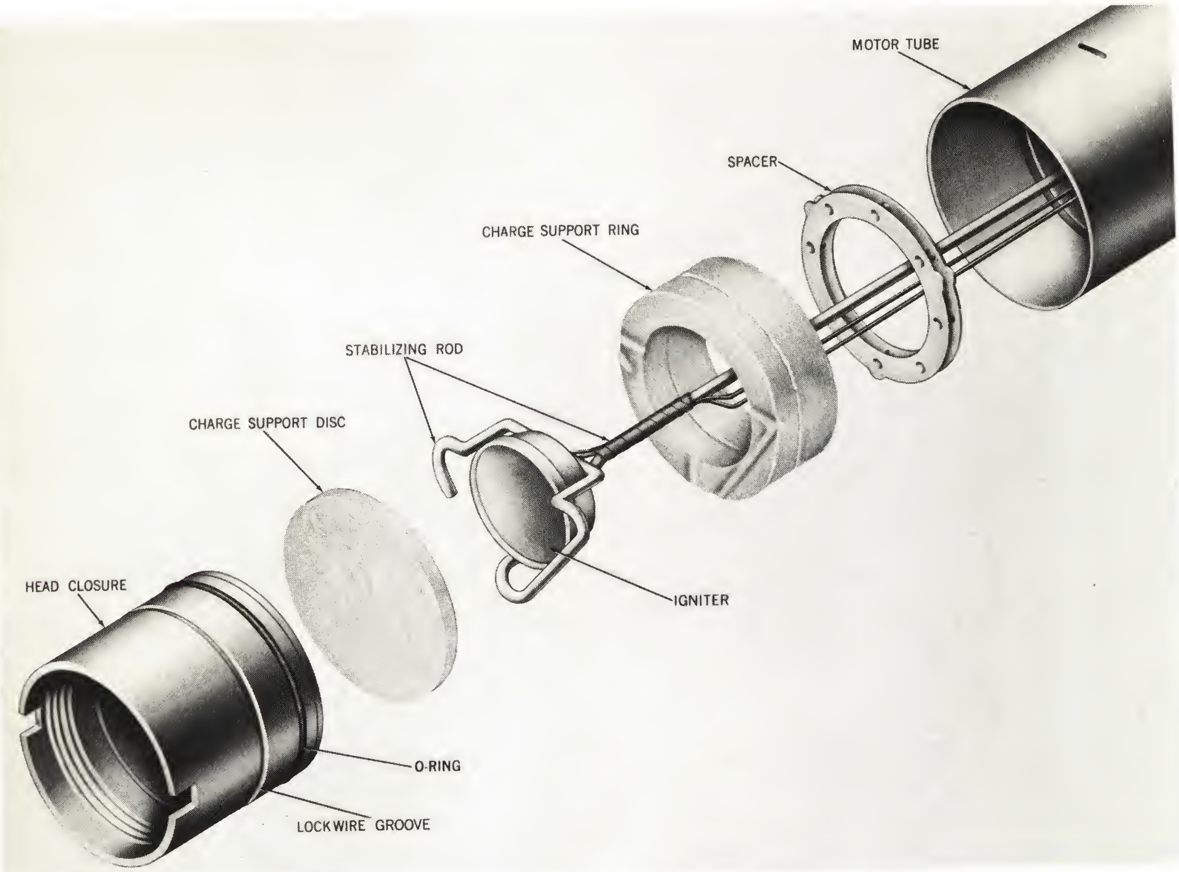


Figure 3–5. Components in Forward End of 2.75-Inch FFAR Motor, Exploded View.

General

The 2.75-inch motors are basically the same as the motors that power other aircraft rockets, except for the folding-fin apparatus.

Motor Tube

The forward end of the tube, figure 3–5, is grooved internally to receive the lockwire that secures the warhead closure. The after end, figure 3–6, has a similar groove for lockwire attachment of the nozzle-fin assembly. The tube is made of light gage aluminum since it does not support threads at either end and since the internal-burning propellent grain produces less heat on the walls of the tube than does an external-burning propellent grain.

Warhead Closure

This component, figure 3–5, is grooved externally to receive the lockwire that secures it to the motor tube. On the after end is another groove fitted with a rubber O-ring that prevents the escape of gas from the tube during burning and serves as an atmospheric seal during storage. The after end of the warhead closure is a thin disc that functions as a blow-out diaphragm in case of accidental ignition prior to assembly of the warhead to the motor. The threads on the inside of the warhead closure receive the threads of the warhead in assembly of the complete round.

Charge Support Disc

This glass fiber disc, figure 3–5, between the warhead closure and the igniter serves to cushion the igniter against shocks.

Igniter

The Igniter Mk 125 is similar to most other aircraft rocket igniters. One of its leads is grounded to the nozzle plate and the other passes through a nozzle to a contact disc, figure 3–7, on the end of the nozzle-fin assembly. A blow-out disc in the after end of the igniter facilitates release of the pressure and heat that build up inside the igniter case when the igniter mixture, consisting primarily of black powder and magnesium, is initiated. For these igniters, a minimum firing current per round of 1.5 amperes for 10 milliseconds is required. The recommended firing current is 3 amperes per round. If the current is less that 1.5 amperes, a delay in ignition may be expected.

Charge Support Ring

This glass fiber cylinder, figure 3–5, supports and cushions the propellent grain and the igniter.

Spacer

The purpose of this double ring is to separate the forward end of the propellent grain and the charge support ring.

Stabilizing Rod

This component provides structural support for the igniter and igniter leads. Felt washers on the rod serve to position it in the center of the hole in the propellent grain. These washers are consumed in the burning of the propellant. This rod also controls the vibration caused by resonant burning.

Propellent Grain

This grain differs from the other aircraft rocket grains in its physical shape and chemical composition, figure 1–6. Substantially all of the external surface is coated with a plastic inhibitor to control the burning surfaces and resultant pressures. The internal perforation of the grain, where burning takes place, is an eight-point star configuration. Unlike some other cylindrical grains, there are no radial perforations in this type of grain. Some grains for the 2.75-inch rockets are made of N5 propellant, which is relatively insensitive to temperature changes; hence, the ballistics of rounds so equipped are the same over a wide temperature range.

Seal Ring

A rubber ring fitted over the end sleeve next to the plastic ring prevents the escape of gas around the circumference of the nozzle plate while the propellant is burning; it also cushions the propellant against shocks from the rear.

Nozzle-Fin Assembly

This assembly is secured to the after end of the motor tube by a lockwire, figure 3–6. A rubber O-ring seals the joint against internal gas pressure during burning and provides an atmospheric seal during storage.

The nozzle-fin assembly consists basically of a nozzle plate, a fin-actuating mechanism, four fins, and a fin retainer.

Nozzle Plate. Unlike that of other aircraft rockets, the after end of this nozzle plate, figure 3–6, extends past the end of the motor tube. This part of the nozzle plate is grooved externally to receive a latch that secures the round when loaded in a launcher. Fixed to the plate are four inserts, or nozzles, which control the release of gases from the burning propellant. In the center of the nozzle plate is a cylinder which houses the piston that actuates the movable fins.

Fin-Actuating Mechanism. The piston in the cylinder of the nozzle plate, figure 3–8, is attached to a crosshead at the after end by an elastic stop nut. Gas pressure from the burning propellant moves the piston, pushing the crosshead against the heels of the fins and thereby opening the fins, figure 3–9.

Fins. The fins are shaped aluminum-alloy plates attached by pivot pins, figure 3–9, to lugs machined on the after side of the nozzle

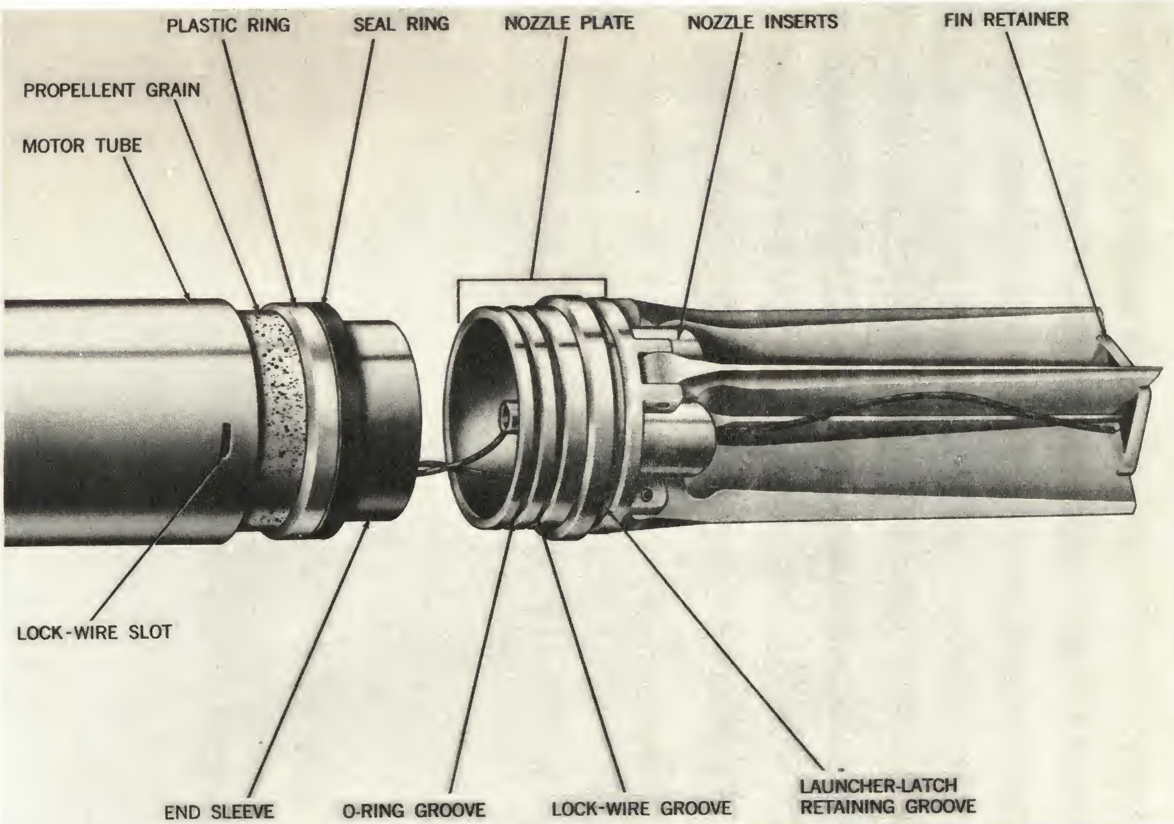


Figure 3–6. Nozzle-Fin Assembly and After End of 2.75-Inch FFAR Motor, with Propellent Grain Partially out of Motor Tube.

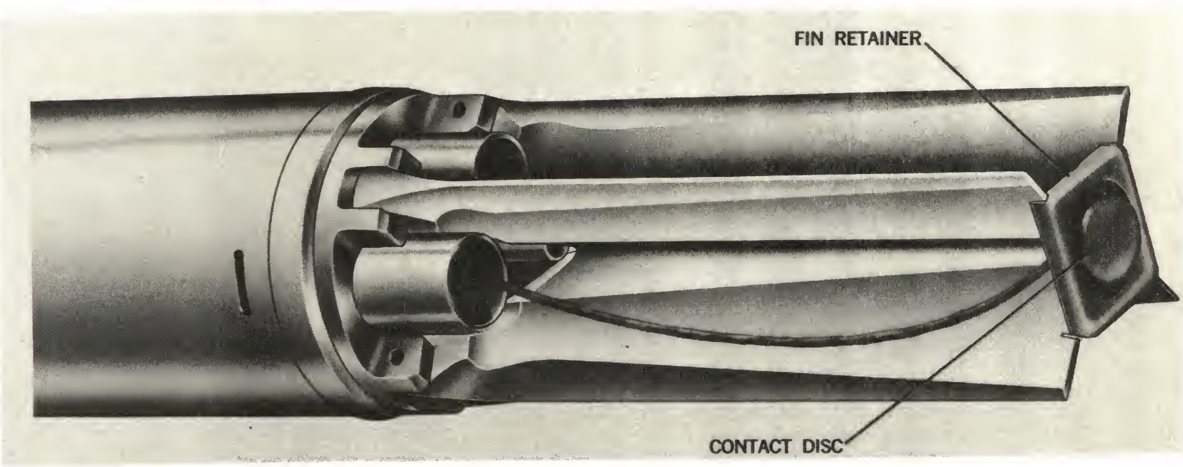


Figure 3–7. Nozzle-Fin Assembly, Fins Closed.

plate. They are notched at the tips and on the trailing edges near the tip, figure 3–8, to fit the fin retainer.

Fin Retainer. The fin retainer is a square aluminum frame, figure 3–7, which holds the fins in the folded position. It is fitted with an insulated cadmium-plated brass contact disc which is connected to the live igniter lead.

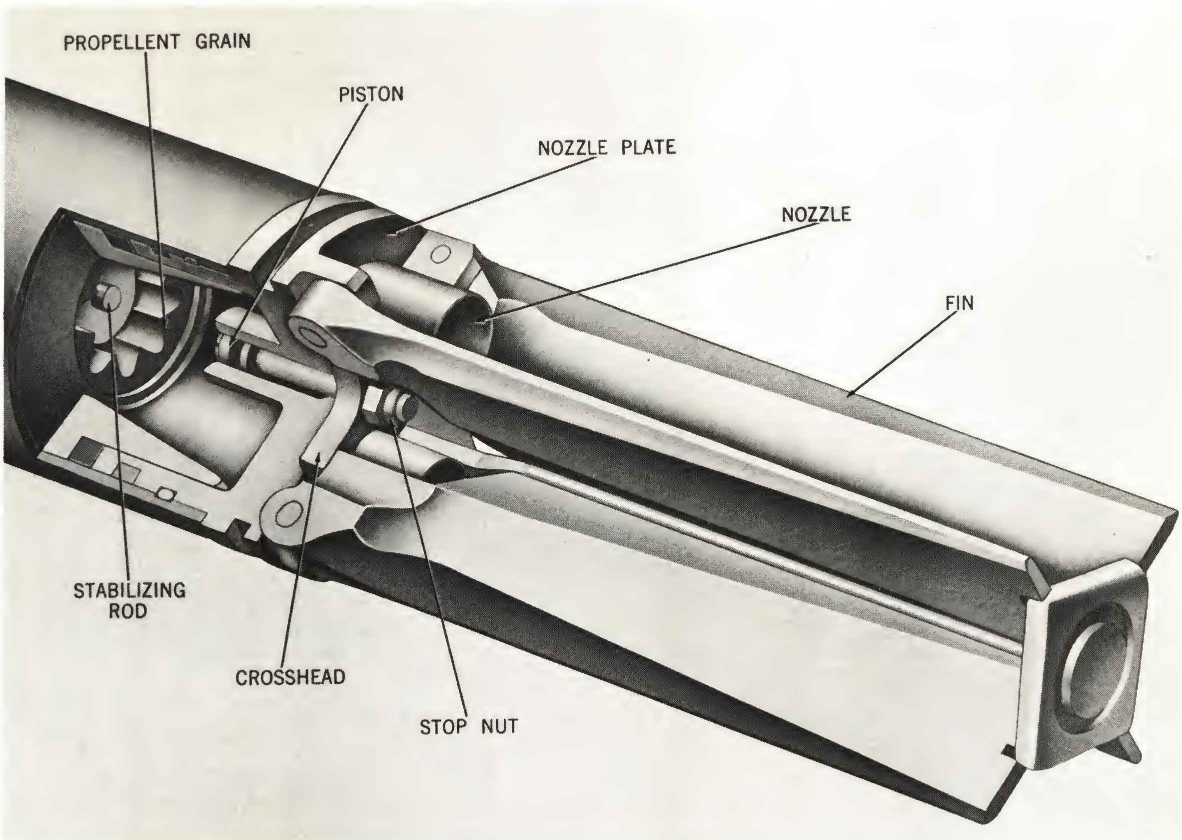


Figure 3–8. Nozzle-Fin Assembly, Cutaway View.

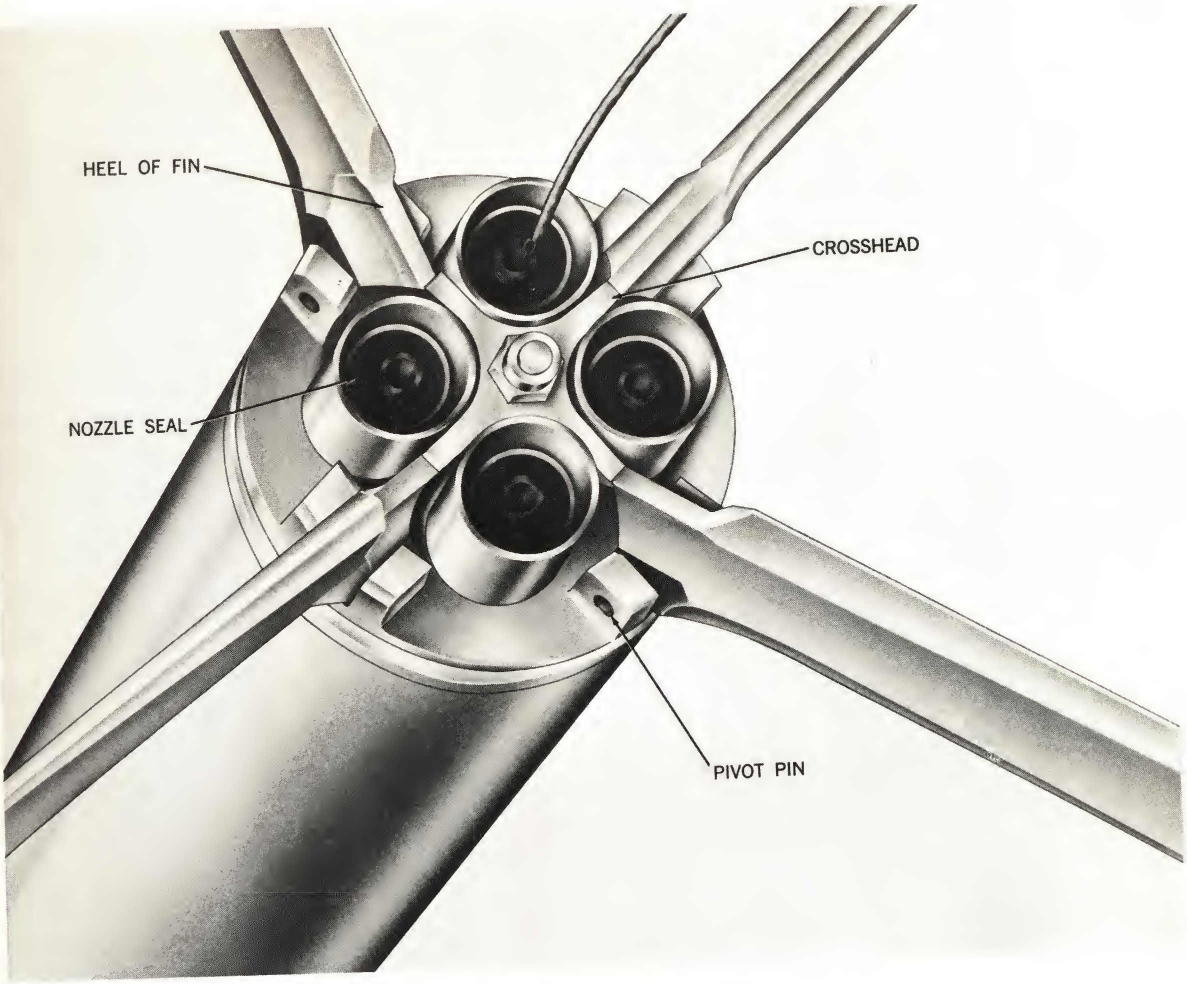


Figure 3–9. Fins in Flight Position.

2.75-INCH ROCKET MOTOR MK 1 MODS 3 AND 4

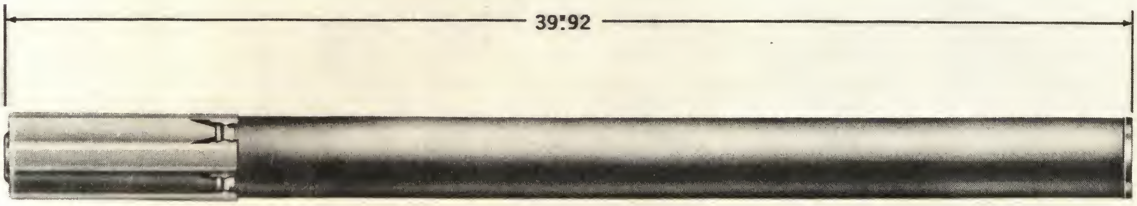


Figure 3–10. 2.75-Inch Rocket Motor, External View, with Fin Retainer in Place.

Mark	1	1
Mod	3	4
Lot No. Prefix	RMHA	RMHA
List of Drawings	174925	174994
Loading Assembly No.	656139	656688
Type Stabilization	Folding Fin	Folding Fin
Overall Shipping Length (in.)	39.92	39.92
Length without Details (in.)	39.36	39.36
Nominal Weight Shipped (lb)	12.85	12.85
Nominal Weight Fired (lb)	11.52	11.52
Thrust (lb)	720	720
Largest Diameter as Shipped (in.)	3.01	3.01
Burning Time (sec.)	1.69	1.69
Propellent Grain Mk-Mod	31–1	31–1
Igniter Mk-Mod	125–2	125–2

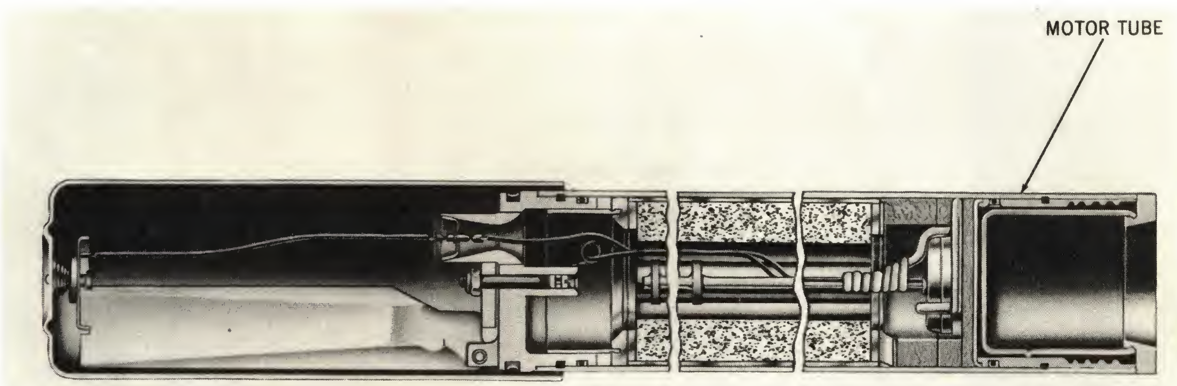


Figure 3–11. 2.75-Inch Rocket Motor Mk 1 Mod 4, Sectional View.

Special Information

The motor tube of the Mod 3 is aluminum alloy; the tube of the Mod 4 is clad aluminum.

2.75-INCH ROCKET MOTOR MK 2 MODS 0, 1, 2, AND 3

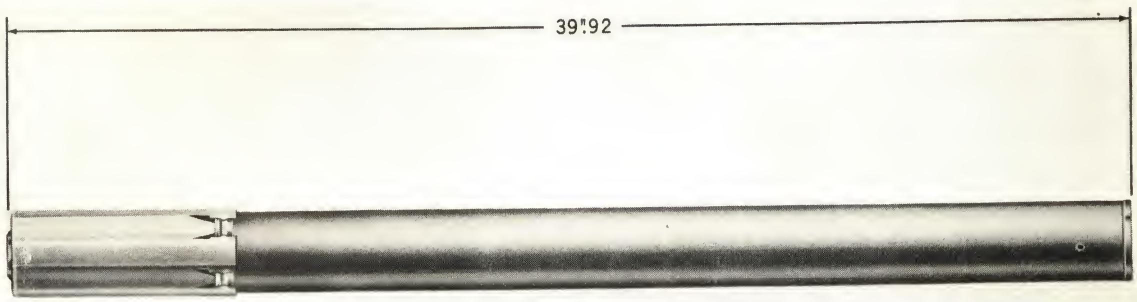


Figure 3–12. 2.75-Inch Rocket Motor Mk 2 Mod 3, External View.

Mark	2	2	2	2
Mod	0	1	2	3
Lot No. Prefix	RMHA	RMHA	RMHA	RMHA
List of Drawings	175025	175013	175014	175024
Loading Assembly No.	656708	656696	656705	656707
Type Stabilization	Folding Fin	Folding Fin	Folding Fin	Folding Fin
Overall Shipping Length (in.)	39.92	39.92	39.92	39.92
Length without Details (in.)	39.36	39.36	39.36	39.36
Nominal Weight Shipped (lb)	12.62	12.62	12.62	12.62
Nominal Weight Fired (lb)	11.32	11.32	11.32	11.32
Thrust (lb)	720	720	720	720
Largest Diameter as Shipped (in.)	3.01	3.01	3.01	3.01
Burning Time (sec.)	1.69	1.69	1.69	1.69
Propellent Grain Mk-Mod	43–0	43–1	43–0	43–1
Igniter Mk-Mod	125–2, 4	125–2, 4	125–2, 4	125–2, 4

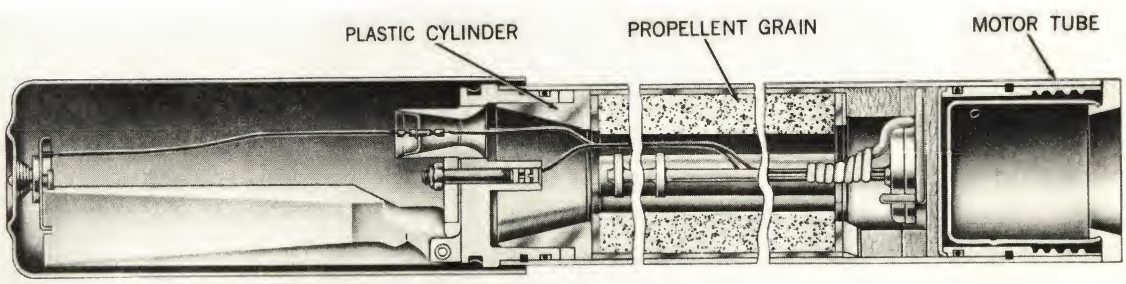


Figure 3–13. 2.75-Inch Rocket Motor Mk 3 Mod 4, Sectional View, with Fin Retainer in Place.

Special Information

The Propellent Grain Mk 43 Mod 0 used with the 2.75-Inch Rocket Motor Mk 2 is made of N4 propellant; the Mod 1 propellent grain is made of N5 propellant, which is relatively insensitive to temperature changes.

The Mod 1 motor differs from the Mod 0 in its propellent grain and in a solid plastic cylinder that replaces the metal end sleeve in the Mod 0. Both the Mod 0 and the Mod 1 have a motor tube made of an aluminum alloy.

Mods 2 and 3 have a motor tube of clad aluminum. The Mod 3 differs from the Mod 2 in its propellent grain and in a solid plastic cylinder that replaces the metal end sleeve in the Mod 2.

2.75-INCH ROCKET MOTOR MK 3 MODS 0, 1, 2, AND 3

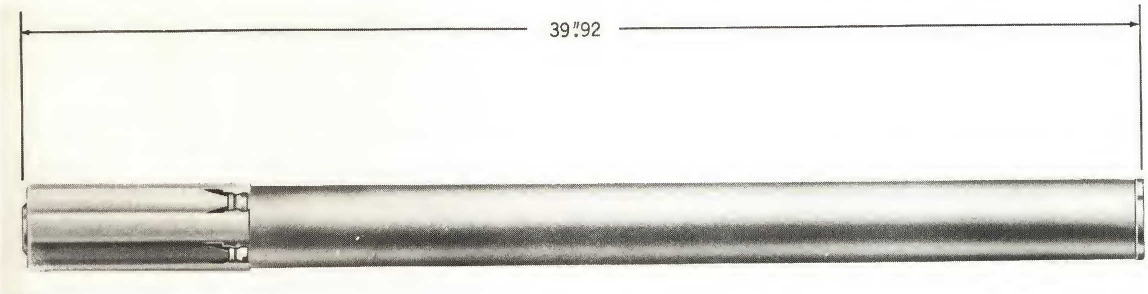


Figure 3–14. 2.75-Inch Rocket Motor Mk 3 Mod 3, External View.

Mark	3	3	3	3
Mod	0	1	2	3
Lot No. Prefix	RMHA	RMHA	RMHA	RMHA
List of Drawings	268493	268494	268495	268496
Loading Assembly No.	656841	656842	656843	656844
Type Stabilization	Folding Fin	Folding Fin	Folding Fin	Folding Fin
Overall Shipping Length (in.)	39.92	39.92	39.92	39.92
Length without Details (in.)	39.36	39.36	39.36	39.36
Nominal Weight Shipped (lb)	12.70	12.70	12.70	12.70
Nominal Weight Fired (lb)	11.40	11.40	11.40	11.40
Thrust (lb)	720	720	720	720
Largest Diameter as Shipped (in.)	3.01	3.01	3.01	3.01
Burning Time (sec.)	1.69	1.69	1.69	1.69
Propellent Grain Mk-Mod	43–0	43–1	43–0	43–1
Igniter Mk-Mod	125–4	125–4	125–4	125–4

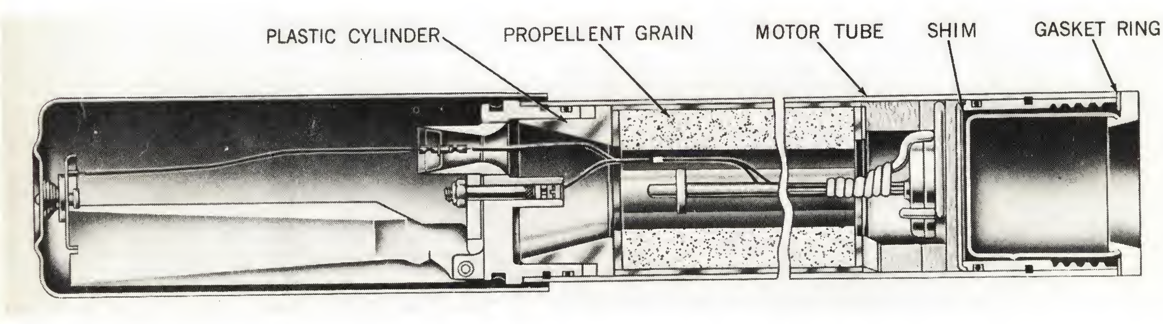


Figure 3–15. 2.75-Inch Rocket Motor Mk 3 Mod 3, Sectional View.

Special Information

Propellent Grain Mk 43 Mod 0 used with 2.75-Inch Rocket Motor Mk 3 is made of N4 propellant; the Mod 1 propellent grain is made of N5 propellant, which is relatively insensitive to temperature changes.

The stabilizing rod in the Mk 3 motors is coated with potassium salt to reduce air-

craft engine flame-outs. The salt, when heated, releases oxygen to assist combustion of the propellent grain and to prevent oxygen starvation of the aircraft jet engine.

The Mod 1 motor differs from the Mod 0 in its propellent grain and in a solid plastic cylinder that replaces the metal end sleeve in the Mod 0. Both the Mod 0 and Mod 1 have a motor tube made of aluminum alloy.

Mods 2 and 3 have a motor tube of clad aluminum. The Mod 3 differs from the Mod 2 in its propellent grain and in a solid plastic cylinder that replaces the metal end sleeve in the Mod 2.

Latest production of Mk 3 motors embodies two components in the forward end which are not found in earlier motors. A gasket ring is placed under the lip of the head shipping support, and a shim is placed between the base of the head shipping support and the blow-out disc of the head closure. The shipping support, a rubber ring, and shim shall be removed before assembling the warhead to the motor.

2.75-INCH ROCKET MOTOR MK 4 MODS 0, 1, 2, 3, 4, 5, 6, AND 7

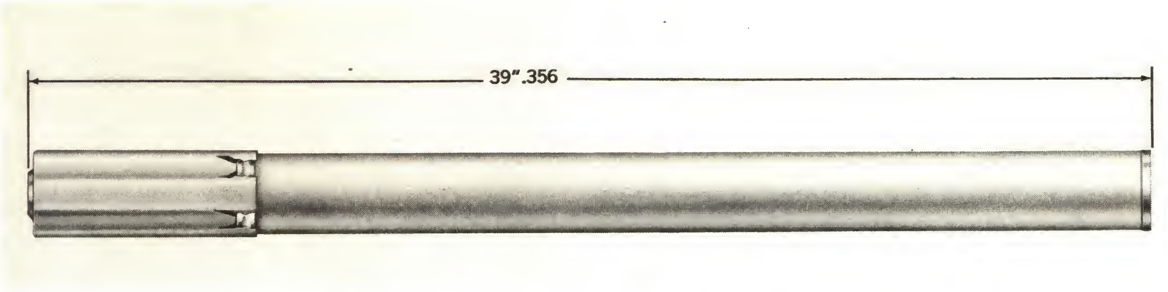


Figure 3–16. 2.75-Inch Rocket Motor Mk 4 Mod 0, External View.

Mark	4	4	4	4	4	4	4	4
Mod	0	1	2	3	4	5	6	7
Lot No. Prefix	RMHA	RMHA	RMHA	RMHA	RMHA	RMHA	RMHA	RMHA
List of Drawings	267914	267915	267916	267917	267918	267919	267920	267921
Loading Assembly No.	657113	657114	657115	657116	657117	657118	657119	657120
Type Stabilization	Folding Fin	Folding Fin	Folding Fin	Folding Fin	Folding Fin	Folding Fin	Folding Fin	Folding Fin
Overall Shipping Length (in.)	39.92	39.92	39.92	39.92	39.92	39.92	39.92	39.92
Length without Details (in.)	39.36	39.36	39.36	39.36	39.36	39.36	39.36	39.36
Nominal Weight Shipped (lb)	12.70	12.70	12.70	12.70	12.70	12.70	12.70	12.70
Nominal Weight Fired (lb)	11.40	11.40	11.40	11.40	11.40	11.40	11.40	11.40
Thrust (lb)	720	720	720	720	720	720	720	720
Largest Diameter as Shipped (in.)	3.01	3.01	3.01	3.01	3.01	3.01	3.01	3.01
Burning Time (sec)	1.69	1.69	1.69	1.69	1.69	1.69	1.69	1.69
Propellent Grain Mk-Mod	43–0	43–0	43–0	43–0	43–1	43–1	43–1	43–1
Igniter Mk-Mod	125–4	125–4	125–4	125–4	125–4	125–4	125–4	125–4

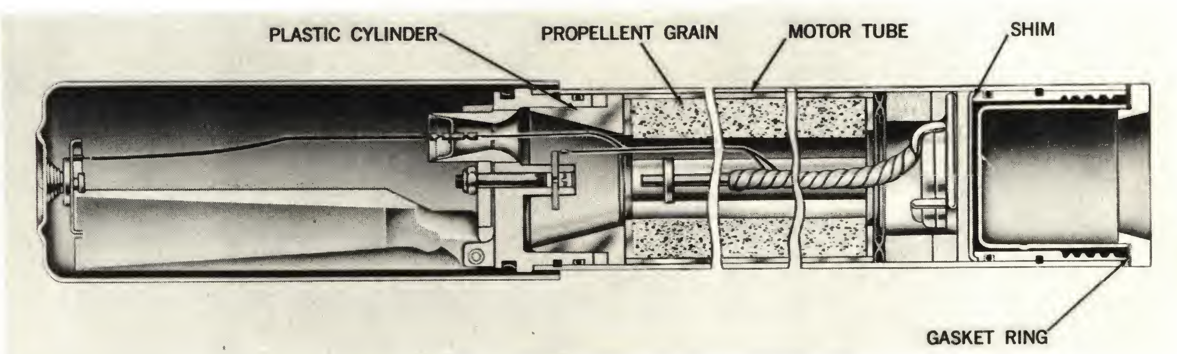


Figure 3–17. 2.75-Inch Rocket Motor Mk 4 Mod 0, Sectional View.

Special Information

The Propellent Grain Mk 43 Mod 0 used with the 2.75-Inch Rocket Motor Mk 4 is made of N4 propellant; Propellent Grain Mk 43 Mod 1 is made of N5 propellant, which is relatively insensitive to temperature changes.

The stabilizing rod in the Mk 4 motors is only partially coated with potassium salt to reduce aircraft engine flame-outs. The salt, when heated, releases oxygen to assist combustion of the propellent grain and to prevent oxygen starvation of the aircraft jet engine.

Rocket Motor Mk 4 is used with all configurations of 2.75-inch folding-fin aircraft rockets.

5.0-INCH ROCKET MOTOR MK 10 MOD 6

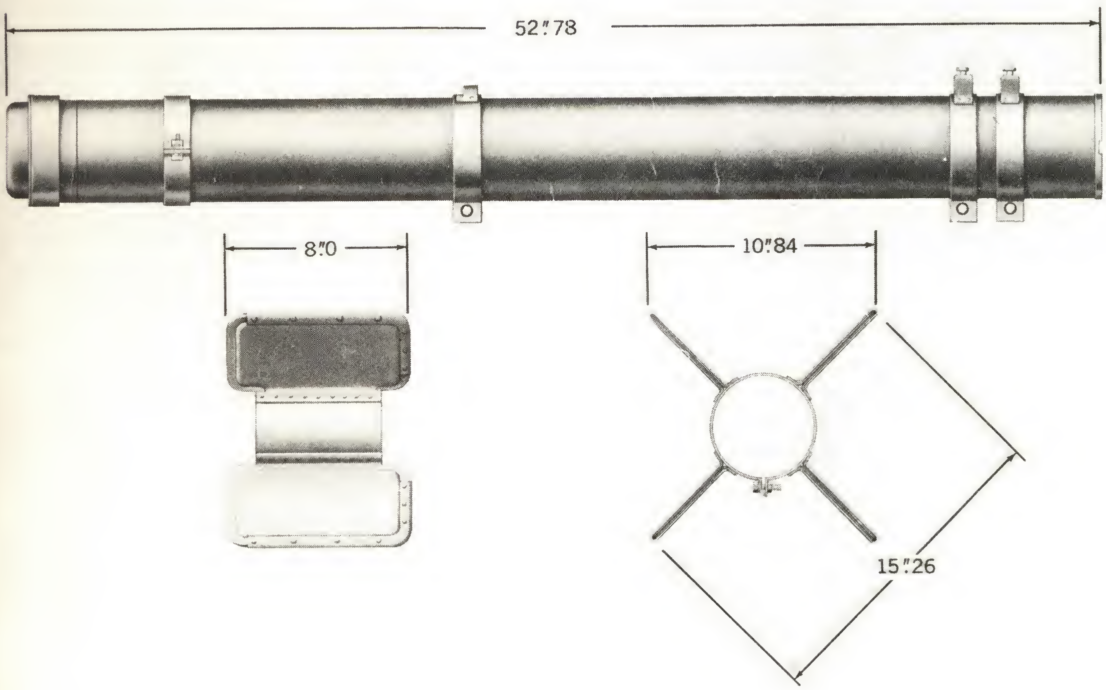


Figure 3–18. 5.0-Inch Rocket Motor Mk 10 Mod 6, External View.

Mark	10
Mod	6
Loading Assembly No.	656724
List of Drawings	268439
Lot No. Prefix	RMDA
Type Stabilization	Fin
Nominal Weight Shipped (lb)	87.16
(with Fin Assembly)	92.66
Nominal Weight Fired (lb)	89.87
Thrust (lb)	4700
Overall Shipping Length (in.)	52.78
Length without Details (in.)	51.31
Fin Diameter (in.)	15.26
Distance between Lugs (in.)	Variable
Burning Time (sec.)	1.15
Propellent Grain Mk-Mod	18–0
Igniter Mk-Mod	114–0 or 1

Electrical Connector:	
Mk-Mod	11–4
Length of Cable (in.)	27.35 (approx)
Container Mk-Mod	6–0
Pallet Adapter Mk-Mod	8–0
Pallet Unit Load	1391943

Special Information

This motor has a cruciform propellent grain and a jack plug electrical connector. The fin assembly is shipped either separately in Rocket Container Mk 6 Mod 0 or assembled to the motor when Pallet Adapter Mk 8 Mod 0 is used.

Suspension bands on this motor may be adjusted to fit various launchers.

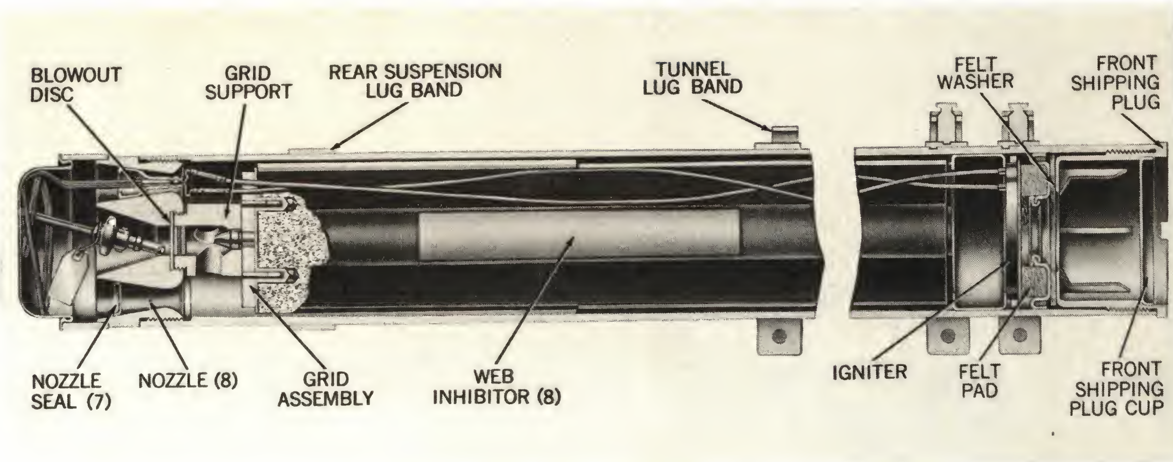


Figure 3–19. 5.0-Inch Rocket Motor Mk 10 Mod 6, Cross Section.

5.0-INCH ROCKET MOTOR MK 16 MOD 1

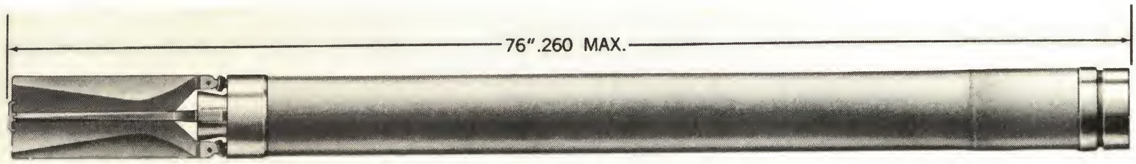


Figure 3–20. 5.0-Inch Rocket Motor Mk 16 Mod 1, External View.

Mark	16
Mod	1
Loading Assembly No.	657377
List of Drawings	267989
Lot No. Prefix	RMZA
Type Stabilization	Folding Fin
Nominal Weight Shipped (lb) (approx)	56.5
Thrust (lb)	7500
Overall Shipping Length (in.)	77.107
Length without Details (in.)	76.260
Fin Diameter (in.)	27.171
Burning Time (sec.)	1.04
Propellent Grain Mk-Mod	49–0
Igniter Mk-Mod	138–0
Maximum Diameter (in.)	5.125

Special Information

General. Designed primarily for use with the 5.0-inch Folding-fin Aircraft Rocket (ZUNI), the Motor Mk 16 Mod 1 uses an internal-burning grain made of temperature-insensitive, low-flash, double-base propellant. The motor tube itself is lightweight aluminum alloy.

Ignition. At the forward end of Motor Tube Mk 19 are a detent groove and a contact band. The detent groove receives the detent latch in the Aero 10D shipper-launcher package. The contact band is a steel strip insulated with a plastic sleeve. The band is connected to the igniter. A metal clip shorts the band when the motor is not in the launcher.

Motor Tube. Rocket Motor Tube Mk 16 is of minimum wall thickness about the pressure chamber, somewhat thicker at the ends. Standard Acme threads at each end join the warhead and the nozzle to the motor. At the forward end of the motor tube is a solid bulkhead. A blowout disc is not required because of the motor's tube-rupturing feature.

Propellant. Solventless extruded from N4 propellant, the star-perforated propellent grain used with Rocket Motor Mk 16 burns fast but with relatively cool, clean, noncorrosive exhaust. The grain is cylindrical and spiral-wrapped with a plastic inhibitor that covers most of the grain's external surface. A salt-coated ballistic rod suspended in the grain perforation reduces flash and afterburning, which contribute to compressor stall (flame-out) on jet aircraft.

Igniter. Rocket Motor Mk 16 uses a tin-can type igniter loaded with FFFG black powder and flaked magnesium. The igniter is initiated by the Squib Mk 1 Mod 0, and ignites the grain by sending a sheet of flame and burning magnesium particles down the perforation.

Generally, Rocket Motor Mk 16 Mod 1 components, notwithstanding the difference in size, are similar to the components of rocket motors used with the 2.75-inch folding-fin aircraft rocket.

At the after end of Rocket Motor Mk 16 tube are four blast-operated fins. These fins are tapered aluminum-alloy blades; the heels lie over the nozzle cone. The first motor gases kick the fins open to latch on ratchet pawls. A small plastic fin retainer disc holds the fins closed before motor firing.

Chapter 4

ROCKET FUZES

NOSE FUZE MK 149 MODS 0 AND 1 (SETBACK-AND-AIR-ARMING, IMPACT-FIRING)

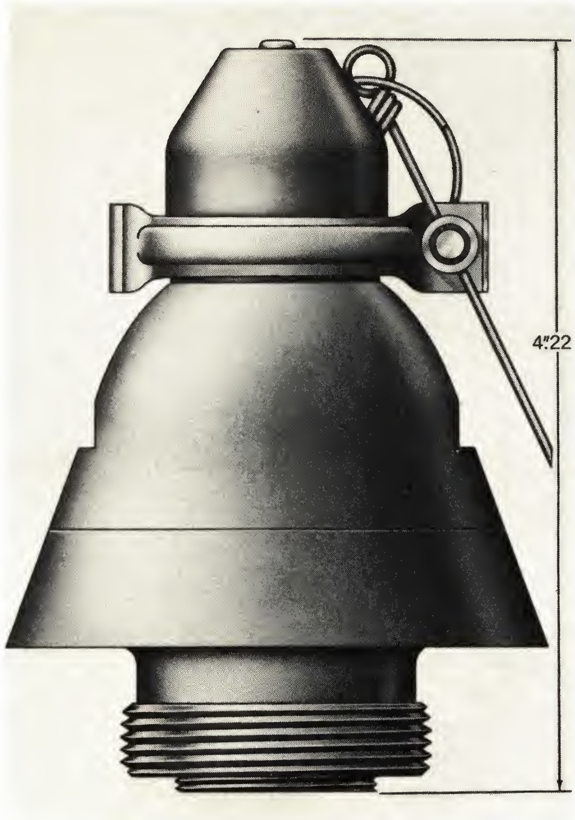


Figure 4–1. Nose Fuze Mk 149 Mod 1, External View.

Mark	149	149
Mod	0	1
General Arrangement	393783	978604
List of Drawings	109204	284796
Ordnance Specifications	3388	3388
Nominal Weight (lb)	2.75	2.75
Overall Length (in.)	4.22	4.22
Armed by	Setback and Air Vanes	Setback and Air Vanes
Fired by	Impact	Impact
Delay Time (sec.)	Instantaneous	Instantaneous
Sensitive to Firing on Water Impact	Yes	Yes
Explosive Components:		
Detonator		
Type	Lead Azide Primer Mixture, Lead Azide, and Tetryl	Lead Azide Primer Mixture, Lead Azide, and Tetryl

Mk-Mod	23–0	23–0
Booster Lead-in	Tetryl	Tetryl
Booster	Tetryl (approx 9 gm)	Tetryl (approx 9 gm)
Packaging:		
Inner Container Mk-Mod	39–0	39–0
Outer Container Mk-Mod	18–0	18–0

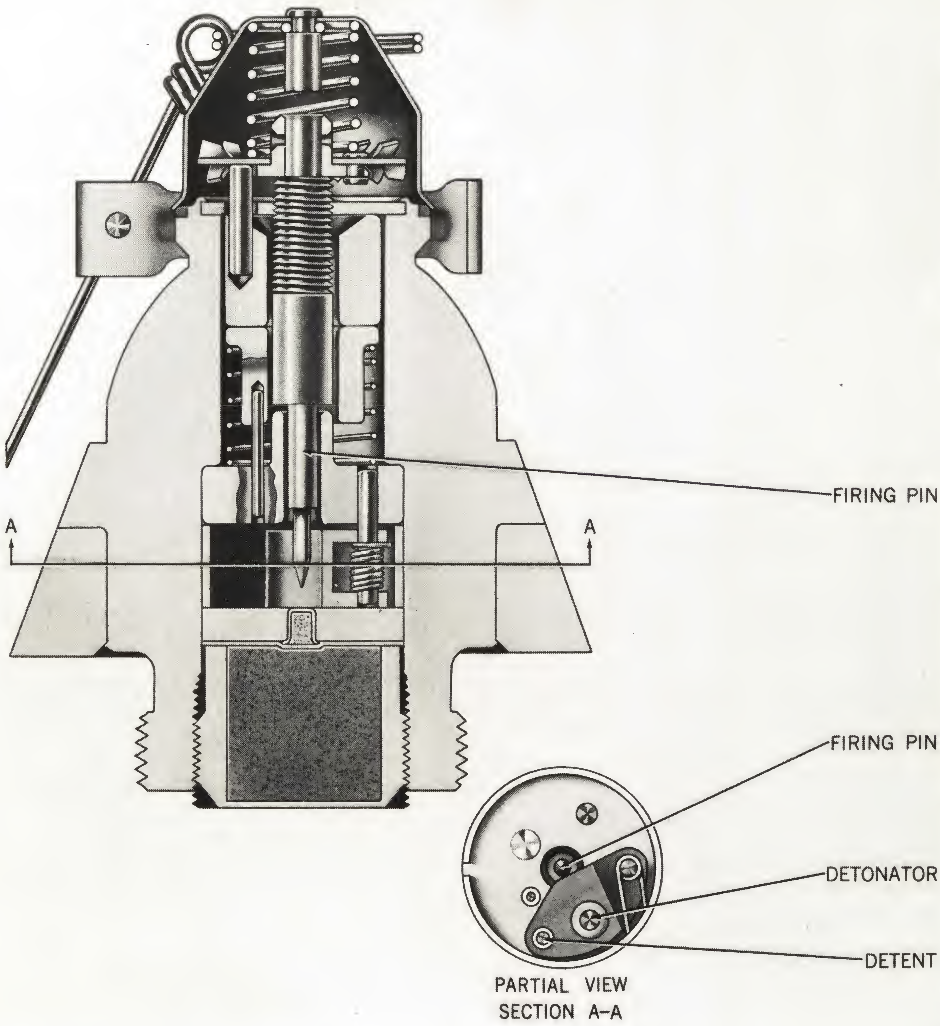


Figure 4–2. Nose Fuze Mk 149 Mod 1, Cross Section, Unarmed Position.

Special Information

This fuze is exactly like the typical set-back-and-air-arming nose fuze described in chapter 1. The firing pin of the Mod 1 is drilled longitudinally to make it collapse in its well in the shutter if the fuze is dropped accidentally while in the unarmed condition. This collapsing prevents it from accidentally initiating the booster lead-in. The firing pin of the Mod 0 is not drilled.

NOSE (VT) FUZE MK 172 MOD 2 (AIR-ARMING, PROXIMITY-FIRING)

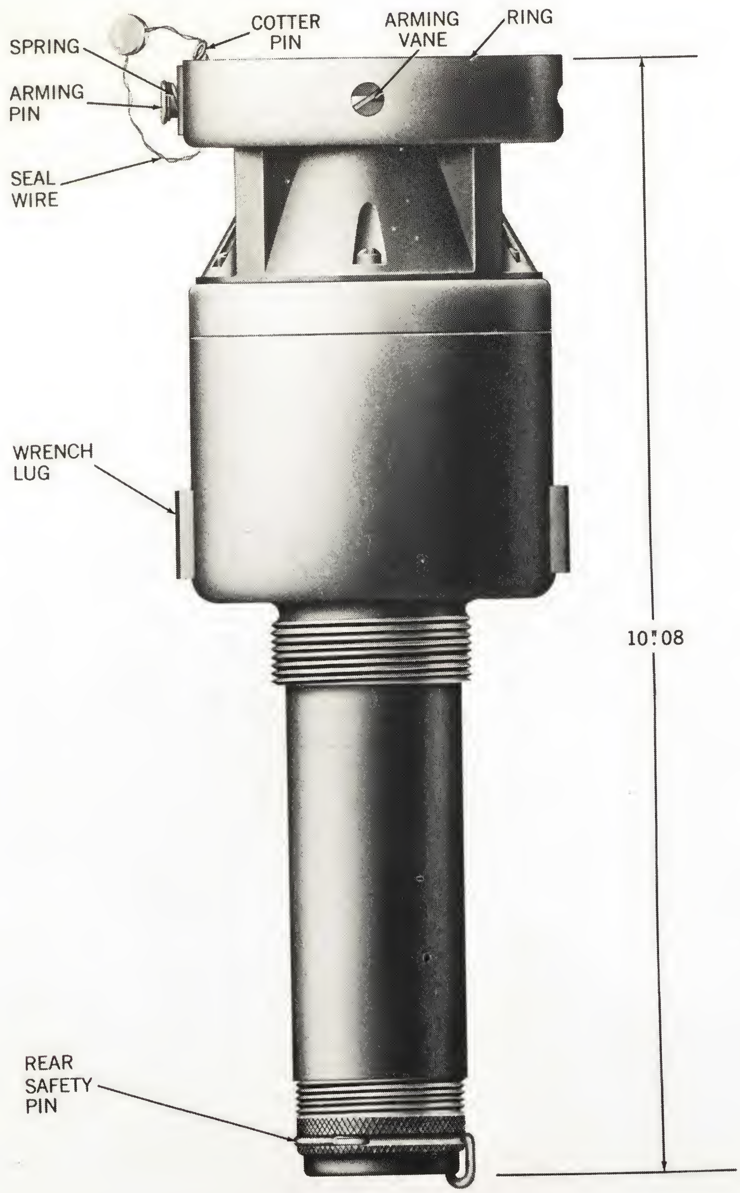


Figure 4–3. Nose (VT) Fuze Mk 172 Mod 2, External View.

Special Information

VT Fuze Mk 172 Mod 2 is designed for air-to-ground firing where air bursts are necessary to spray fragments on personnel or light equipment. This fuze may be used (however, less successfully) in air-to-air firing, but the rocket must come within 20 feet of the aircraft target before the fuze will function.

This fuze must not be used if the seal wire is broken with which the fuze is shipped. Inspect for such defects immediately upon removal from the container.

NOSE (VT) ROCKET FUZE T2061 (AIR-ARMING, PROXIMITY-FIRING)

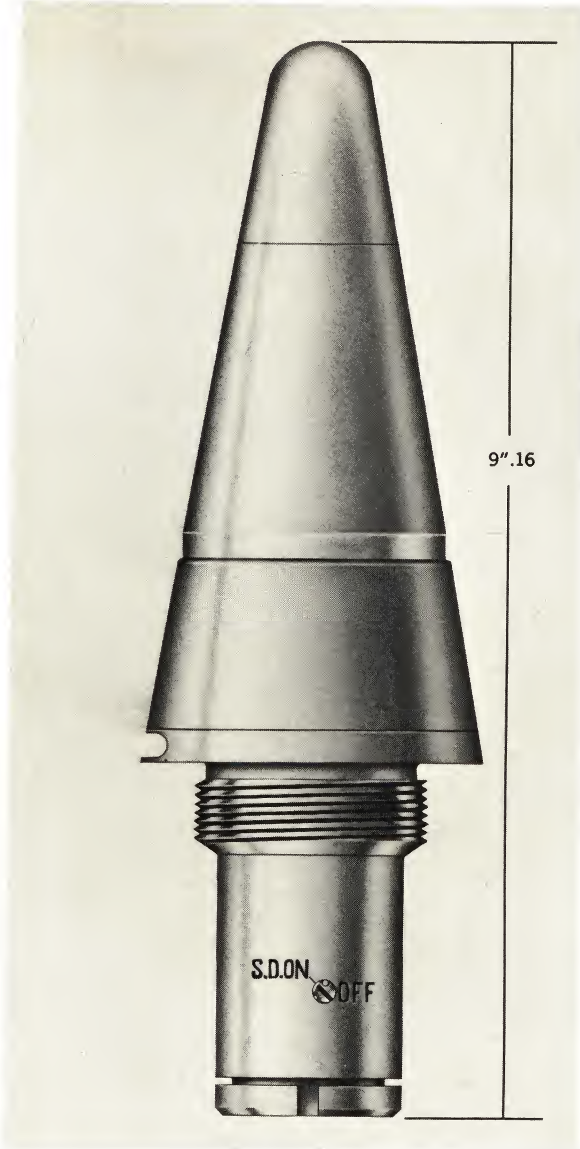


Figure 4–4. Nose (VT) Rocket Fuze T2061, External View.

Special Information

The T2061 fuze is designed for use with Warheads Mk 24 and Mk 32, used with the 5.0-inch Folding-Fin Aircraft Rocket (ZUNI). It is especially effective against aircraft. In air-to-air firing, the T2061 fuze functions within forty feet of the aircraft, a near enough miss, when used with Warhead Mk 32, to kill a heavy bomber.

Since the T2061 fuze is used with shipper-launcher-packages, it has no external arming devices. Its electronic components are completely enclosed in a blunt-nosed, ogival, fuze head.

NOSE FUZE MK 176 MODS 0 AND 1 (ACCELERATION-ARMING, POINT-DETONATING)

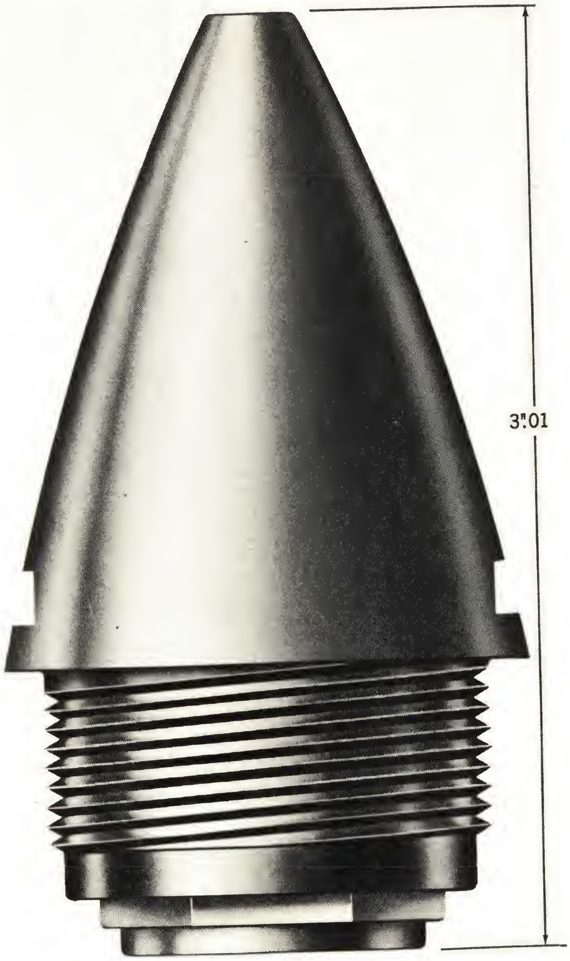


Figure 4–5. Nose Fuze Mk 176 Mod 1, External View.

Mark	176	176
Mod	0	1
General Arrangement	656269	657739
List of Drawings	174737	268456
Nominal Weight (lb)	0.75	0.75
Overall Length (in.)	3.01	3.01
Delay Time (sec.)	0.0003	0.0003
Sensitive to Firing on Water Impact	No	No
Explosive Components:		
Primer:		
Type	Lead azide primer mix	Lead azide primer mix

	and lead azide	and lead azide
Mk-Mod	125–0	125–0
Delay Element:		
Type	Lead peroxide, nickel, and zirconium	Lead peroxide, nickel, and zirconium
Mk-Mod	10–0	10–0
Detonator:		
Type	Tetryl and lead azide	Tetryl and lead azide
Mk-Mod	59–0	59–0
Booster and Lead-in	Tetryl	Tetryl

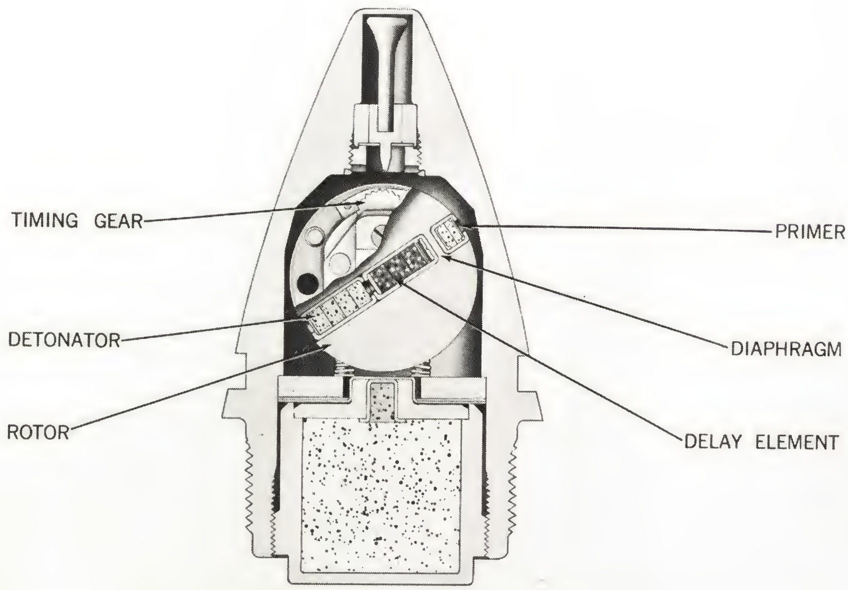


Figure 4–6. Nose Fuze Mk 176 Mod 1 (Acceleration-Arming, Point-Detonating), Unarmed Position, Sectional View.

Special Information

Nose Fuze Mk 176 Mods 0 and 1 is generally similar to the typical acceleration-arming, point-detonating nose fuze described in chapter 1. However, in the Mk 176 fuze, which is designed for delayed action, there is a delay element in the rotor between the primer and the detonator. The rotor is not drilled completely through; a thin diaphragm is left between the well for the primer and the well for the delay element and the detonator. When the primer is initiated by the firing pin, the detonation collapses the diaphragm. The movement of the diaphragm initiates the pressure-sensitive delay element.

The Mod 1 is the production model of this fuze; its timing gear train embodies a balanced escapement. The Mod 0 was the first lot made; its timing mechanism did not include the balanced escapement.

NOSE FUZE MK 178 MODS 0, 1, AND 2 (ACCELERATION-ARMING, POINT-DETONATING)

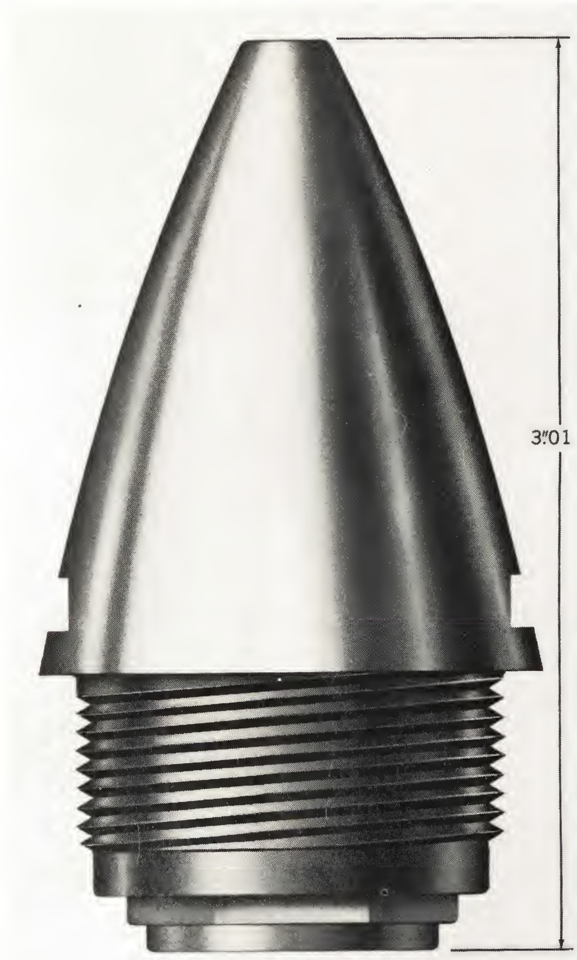


Figure 4–7. Nose Fuze Mk 178 Mod 2, External View.

Mark	178	178	178
Mod	0	1	2
General Arrangement	657178	656065	657740
List of Drawings	174862	174811	265461
Nominal Weight (lb)	0.75	0.75	0.75
Overall Length (in.)	3.01	3.01	3.01
Delay Time (sec.)	None	None	None
Sensitive to Firing on Water Impact	No	No	No
Explosive Components:			
Primer:			

Type	Lead aside primer mix and lead azide	Lead azide primer mix and lead azide	Lead azide primer mix and lead azide
Mk-Mod	125–0	125–0	125–0
Detonator:			
Type	Tetryl and lead azide	Tetryl and lead azide	Tetryl and lead azide
Mk-Mod	59–0	59–0	59–0
Booster and Lead-in	Tetryl	Tetryl	Tetryl

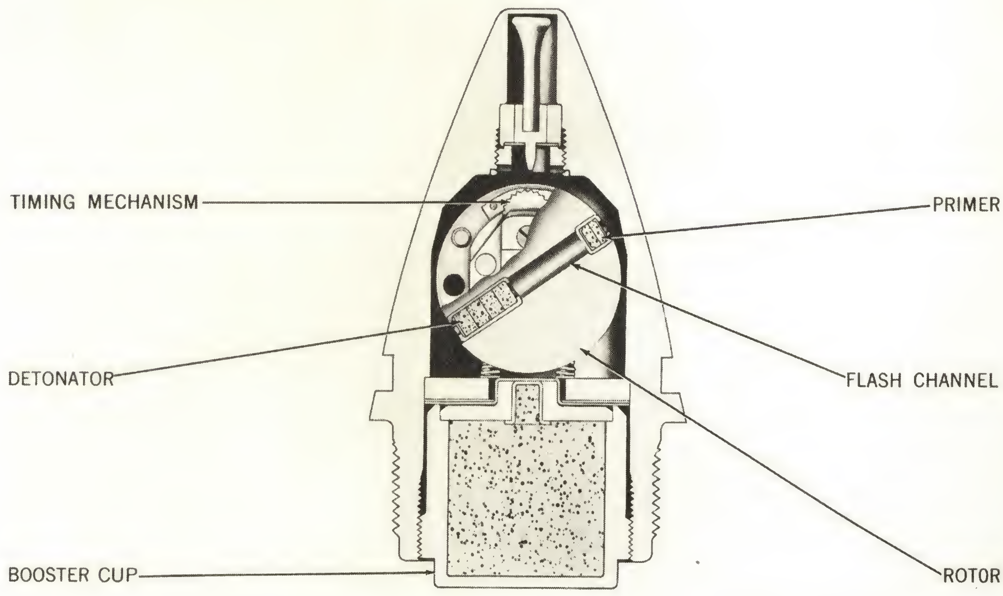


Figure 4–8. Nose Fuze Mk 178 Mod 2, (Acceleration-Arming, Point-Detonating), Unarmed Position, Sectional View.

Special Information

Nose Fuze Mk 178 is similar to the typical acceleration-arming, point-detonating nose fuze described in chapter 1. In the Mk 178 fuze, which is designed for instantaneous action, there is no delay element in the rotor between the primer and the detonator. The rotor is drilled to provide a flash channel from the primer to the detonator.

The Mod 0 employs a rotor built for the Mk 176 fuze which is drilled and fitted with a sleeve for the instantaneous explosive train of the Mk 178. The Mod 1 employs a rotor especially produced for this type of action; no sleeve is necessary. The Mod 2 is the production model of the fuze; it incorporates the new rotor, a balanced escapement in the timing mechanism, and a die-cast booster cup.

NOSE FUZE MK 181 MOD 0 (PRESSURE-ARMING)

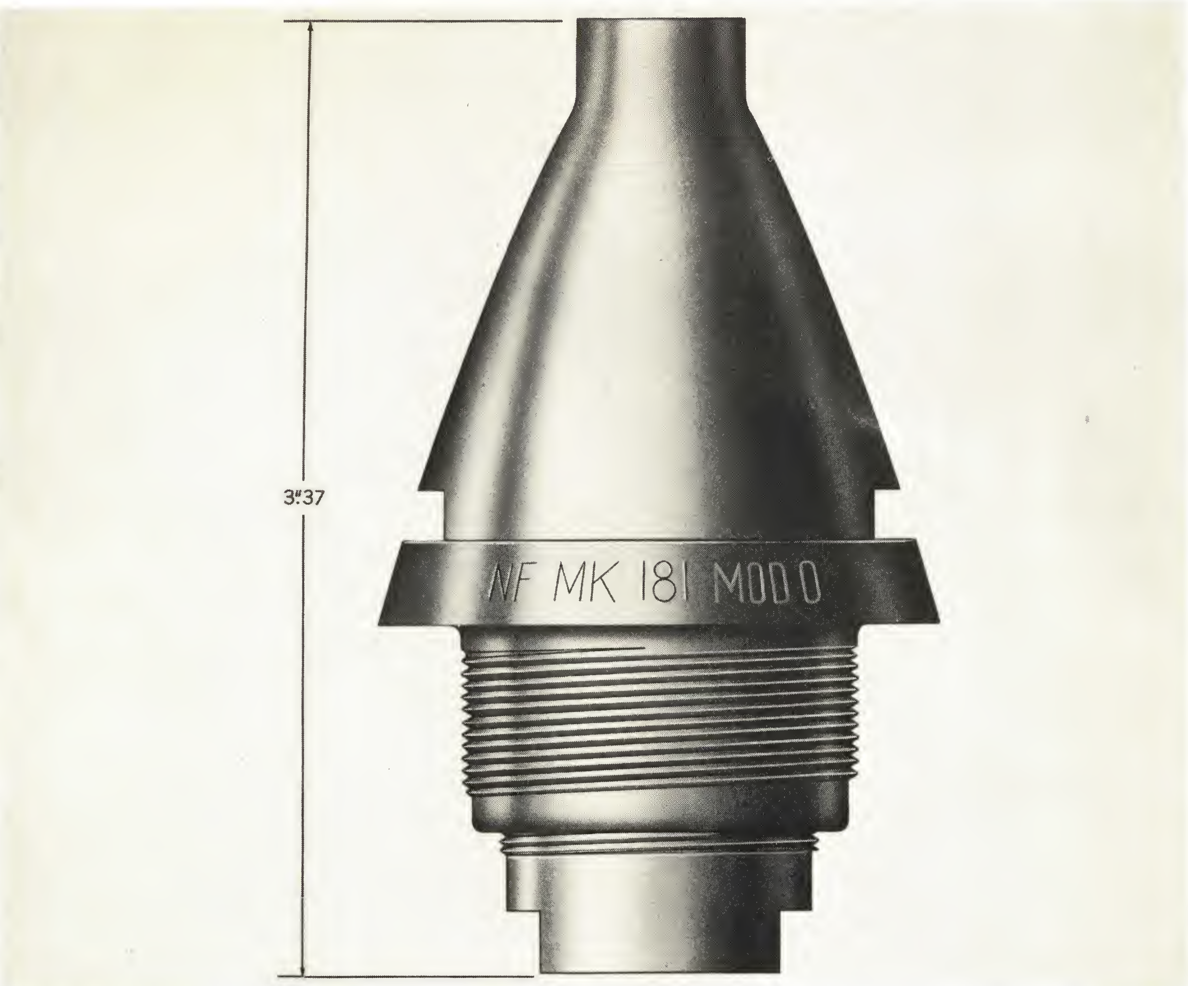


Figure 4–9. Nose Fuze Mk 181 Mod 0, External View.

Mark	181
Mod	0
General Arrangement	1378092
List of Drawings	291708
Nominal Weight (lb)	0.82
Overall Length (in.)	3.365
Delay Time (sec.)	None
Sensitive to Firing on Water Impact	No
Explosive Components:	
Primer:	
Type	Potassium chlorate, antimony sulfide, lead thiocyanate, and lead azide
Model	M 56
Detonator:	
Type	Potassium chlorate, antimony sulfide, lead azide, tetryl, and carborundum
Model	M 29
Lead-ins (2)	RDX mix
Booster:	
Type	RDX mix, shaped charge
Model	M 122

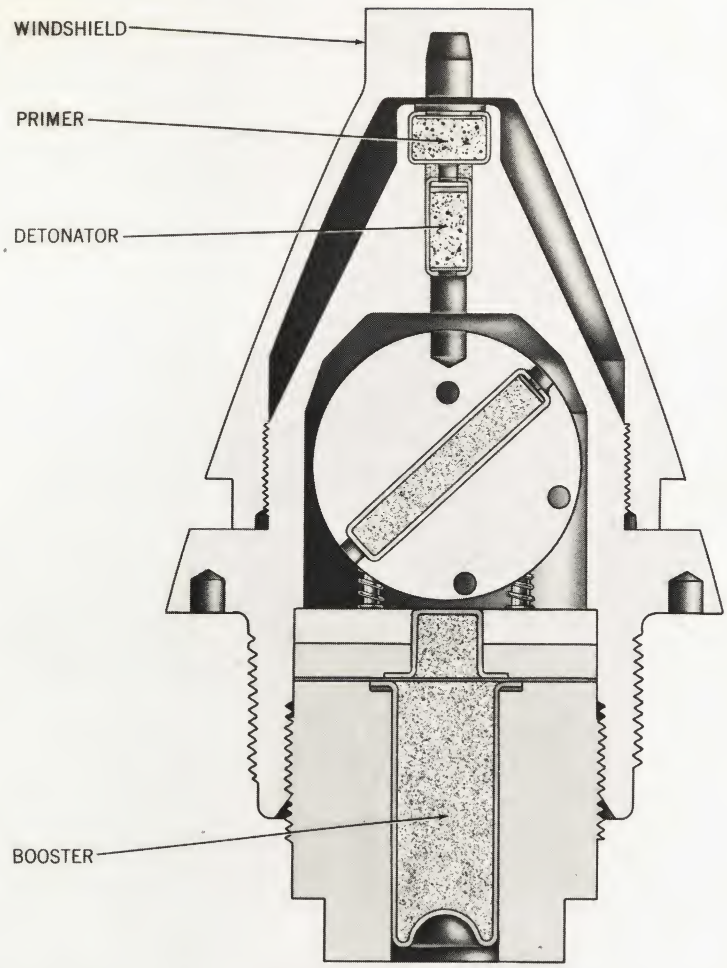


Figure 4–10. Nose Fuze Mk 181 Mod 0 (Acceleration-Arming, Point-Detonating), Unarmed Position, Sectional View.

Special Information

The arming mechanism of the Nose Fuze Mk 181 is similar to that of the typical acceleration-arming, point-detonating nose fuze described in chapter 1. The major innovations in this fuze are the impact-sensitive primer, the absence of a firing pin, and the shaped-charge booster.

The primer is protected from accidental ignition by an air gap between the windshield and that part of the fuze body which houses the primer. At impact velocities as great as 3000 fps, the fuze will function against such targets as earth or mild steel plate of a minimum thickness of 0.125 inch. On plate targets, it will function at angles of attack between 0° and 60° from the perpendicular to the plate.

The Shaped-charge Booster M122, has a concave shape at its after end to direct the explosion of the booster into a jet of high temperature gases. This jet travels to the base of the rocket head, through the cone and flash tube, to ignite the booster pellet and, in turn, the main charge.

Nose Fuze Mk 181 is coated with an organic sealing compound to prevent the entry of moisture and to prolong the effectiveness of the explosive components during storage.

NOSE FUZE MK 188 MOD 0 (ACCELERATION-ARMING, POINT-DETONATING)

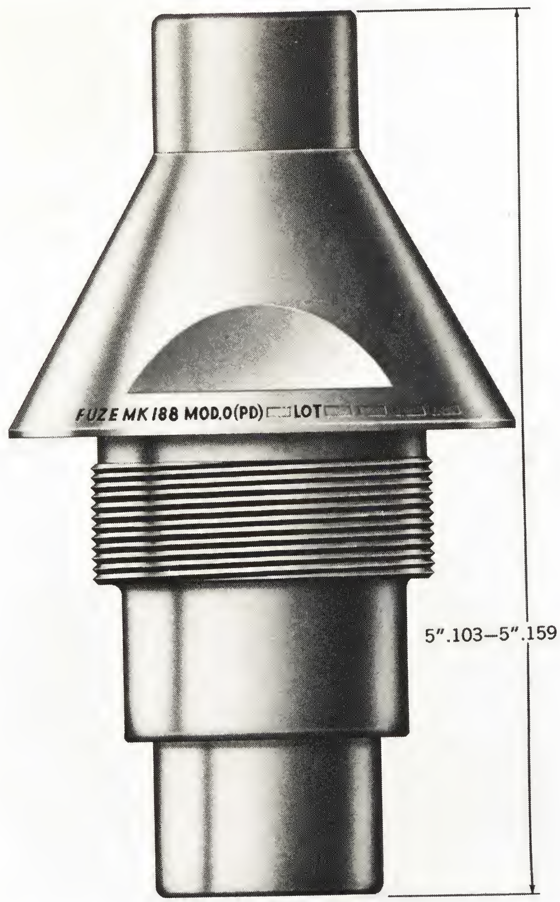


Figure 4–11. Nose Fuze Mk 188 Mod 0, External View.

Special Information

Nose Fuze Mk 188 Mod 0 is designed for use with Rocket Warhead Mk 24 Mod 0, used in conjunction with the 5.0-inch Folding-fin Aircraft Rocket (ZUNI). The only distinctions to be made between this fuze and other acceleration-arming, impact-firing, point-detonating fuzes, described in chapters 1 and 4, are in the firing pin assembly design, dimensions, and actual physical appearance. Nose Fuze Mk 188 Mod 0 contains the same basic components as the other acceleration-arming fuzes. The functional characteristics of the Nose Fuze Mk 188 are typical, as described in the section of chapter 1 on acceleration-arming fuzes.

BASE FUZE MK 164 MOD 0 (PRESSURE-ARMING, IMPACT-FIRING)

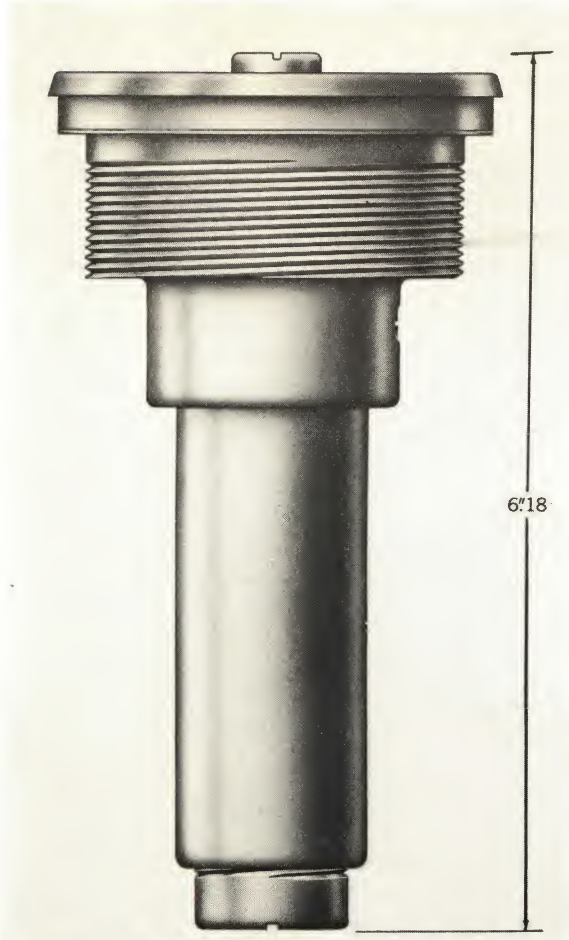


Figure 4–12. Base Fuze Mk 164 Mod 0, External View.

Mark	164
Mod	0
General Arrangement	561460
List of Drawings	165239
Ordnance Specifications	3675
Nominal Weight (lb)	3.45
Overall Length (in.)	6.18
Armed by	Motor-Gas Pressure
Fired by	Impact
Delay Time (sec.)	0.015
Sensitive to Firing on Water Impact	Yes
Explosive Components:	
Delay Element Mk-Mod	7–0
Percussion Primer:	
Type	Mercury Fulminate
Mk-Mod	106–0
Delay Charge	Black Powder
Relay Detonator:	
Type	Lead Azide
Mk-Mod	42–0
Booster Lead-in	Tetryl
Booster	Tetryl (approx 12 gm)
Packaging:	
Inner Container Mk-Mod	35–0
Outer Container Mk-Mod	36–0

Special Information

This fuze is exactly like the typical pressure-arming, impact-firing base fuze described in chapter 1.

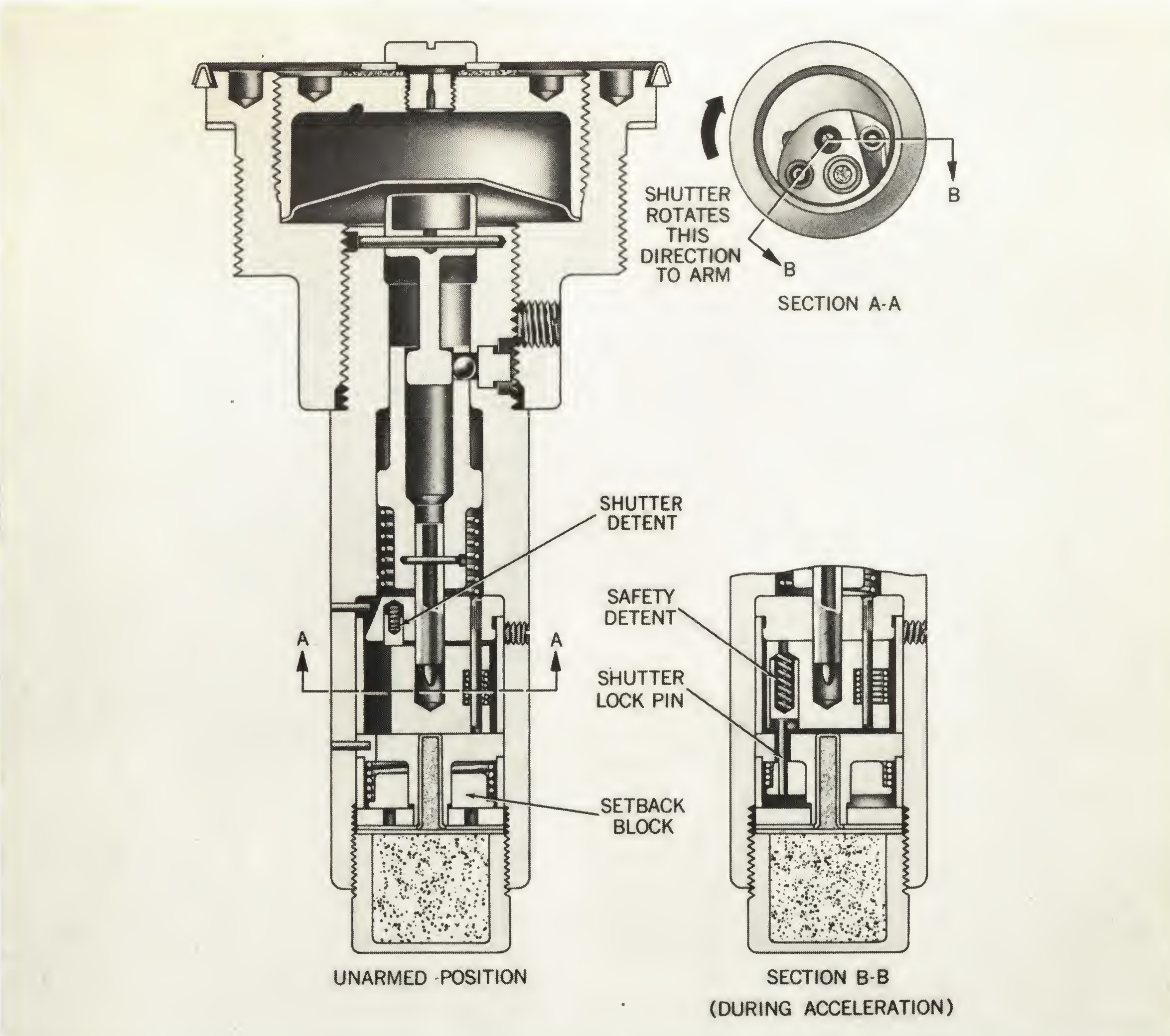


Figure 4–13. Base Fuze Mk 164 Mod 0, Cross Section, Unarmed Position.

BASE FUZE MK 191 MOD 0 (PRESSURE-ARMING, IMPACT-FIRING)

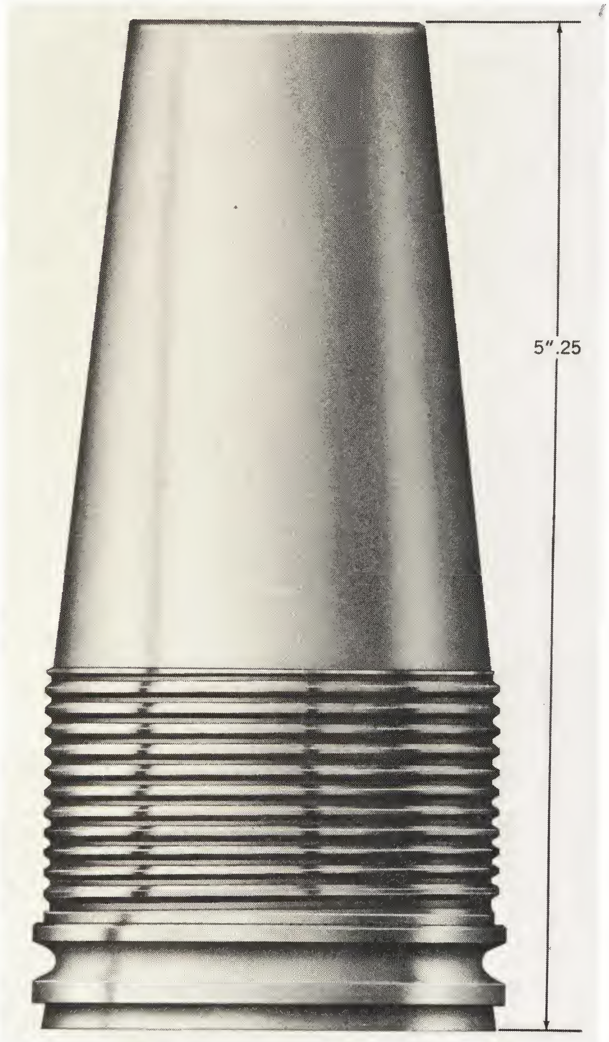


Figure 4–14. Base Fuze Mk 191 Mod 0, External View.

Special Information

Base Fuze Mk 191 Mod 0 is designed for use with the Rocket Warhead Mk 24 for the 5.0-inch, Folding-fin Aircraft Rocket (ZUNI). This fuze is distinguished by its electrical operation which does not require prelaunching charging but, instead, impact-energizes the primer initiating circuit.

BASE FUZE MK 166 MODS 0 AND 2 (PRESSURE-ARMING, DECELERATION-FIRING)

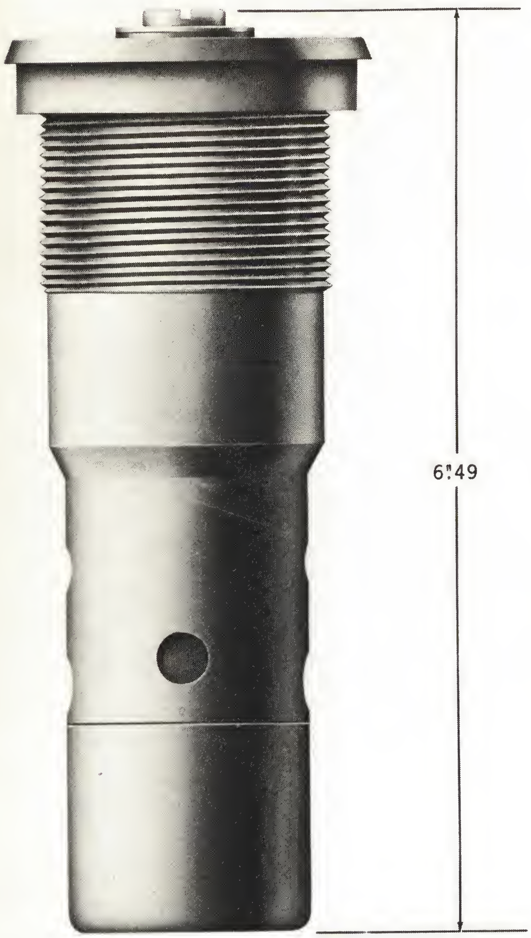


Figure 4—15. Base Fuze Mk 166 Mod 2, External View.

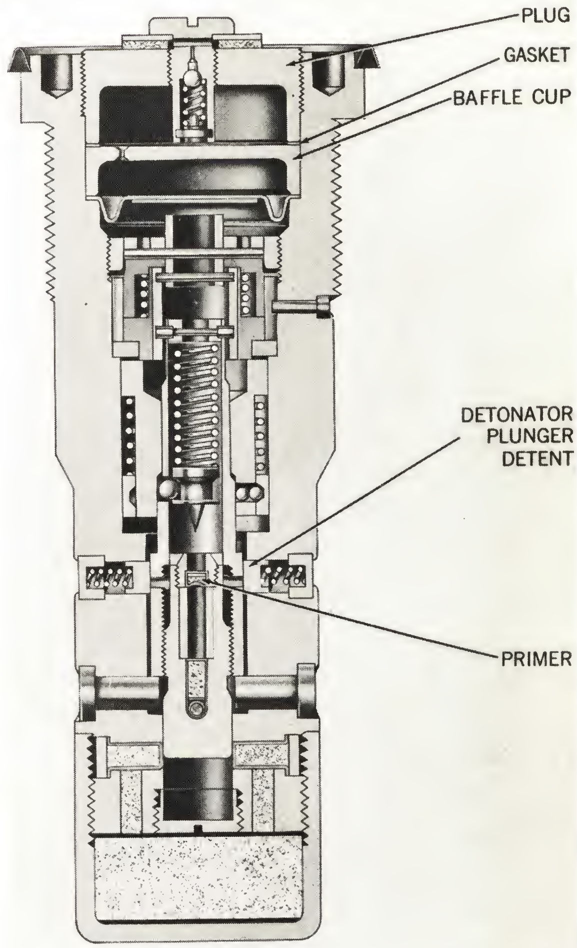


Figure 4—16. Base Fuze Mk 166 Mod 2, Cross Section, Unarmed Position.

Mark	166	166
Mod	0	2
General Arrangement	562011	978505
List of Drawings	165443	284523
Ordnance Specifications	3906	5371
Nominal Weight (lb)	3.90	3.90
Overall Length (in.)	6.49	6.49
Armed by	Motor-Gas Pressure	Motor-Gas Pressure
Fired by	Deceleration	Deceleration
Sensitive to Firing on Water Impact	No	No

Explosive Components:		
Sensitive Primer:		
Type	Mercury Fulminate	Mercury Fulminate
Mk-Mod	102–0	102–1
Detonator:		
Type	Lead Azide	Lead Azide
Mk-Mod	33–1	33–1
Body Lead-ins (2)	Tetryl	Tetryl
Body Lead-outs (2)	Tetryl	Tetryl
Booster	Tetryl (approx 28 gm)	Tetryl (approx 28 gm)
Packaging:		
Inner Container Mk-Mod	56–0	56–0
Outer Container	506945	506945

Special Information

This fuze is exactly like the typical pressure-arming, deceleration-firing base fuze described in chapter 1.

The Mod 2 differs from the Mod 0 in the following respects.

1. The Mod 2 has Primer Mk 102 Mod 1 instead of the Mk 102 Mod 0 in the Mod 0 fuze.

2. The Mod 2 has improved gas sealing. A soft copper gasket is added between the plug and the baffle cup. The threads of the plug are luted with silicone grease.

3. The Mod 2 detonator plunger detent is moved rearward slightly to make its functioning more reliable.

This fuze fires when deceleration of the rocket has reached a level of about 75 G's. This corresponds to a distance of approximately 180 feet of unobstructed underwater travel when the velocity at which the rocket strikes the water is 1700 fps.

Chapter 5

ROCKET ASSEMBLIES

2.25-INCH ROCKET MK 4 MOD 0 (SCAR)

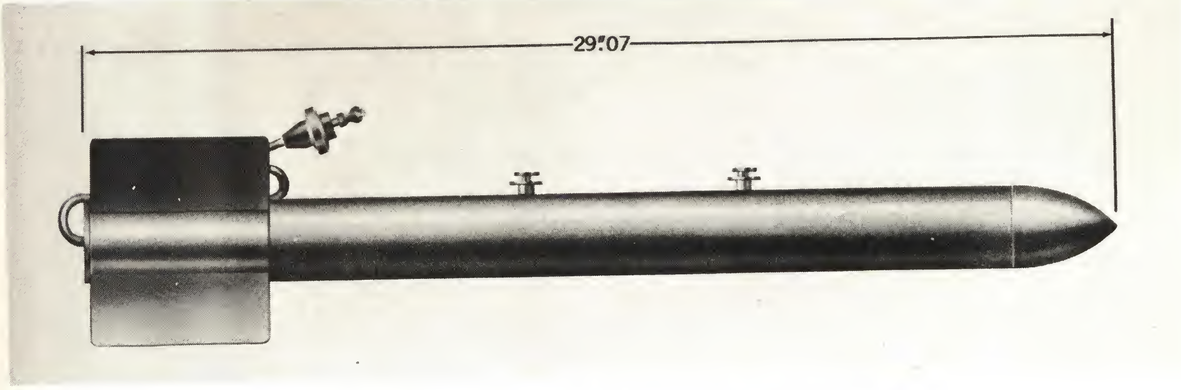


Figure 5–1. 2.25-Inch Rocket Mk 4 Mod 0 (SCAR), External View.

Mark	4
Mod	0
Nominal Velocity (fps)	1110
Nominal Weight (lb)	12.47
Overall Length (in.)	29.07
Head, 2.25-Inch, Mk-Mod	3–0 or 2
Motor, 2.25-Inch, Mk-Mod	15–0, 2, or 3
Nose Fuze Mk-Mod	None
Base Fuze Mk-Mod	None
Time to 1000 yd (sec.) (Temperature at 70° F)	3.2
C.G., Before Burning (in.) (Measured from rear)	12.85
Trajectory Table in OP No.	1829
Container Mk-Mod	2–0

Special Information

The Mk 4 Mod 0 round simulates trajectories of the 5.0-inch HVAR rocket.

The Mk 5 Mod 0 dummy round is used for drill. It is exactly like the Mk 4 Mod 0, except that it uses an inert-loaded 2.25-Inch Rocket Motor Mk 15 All Mods.

2.25-INCH ROCKET MK 6 MOD 0 (SCAR)

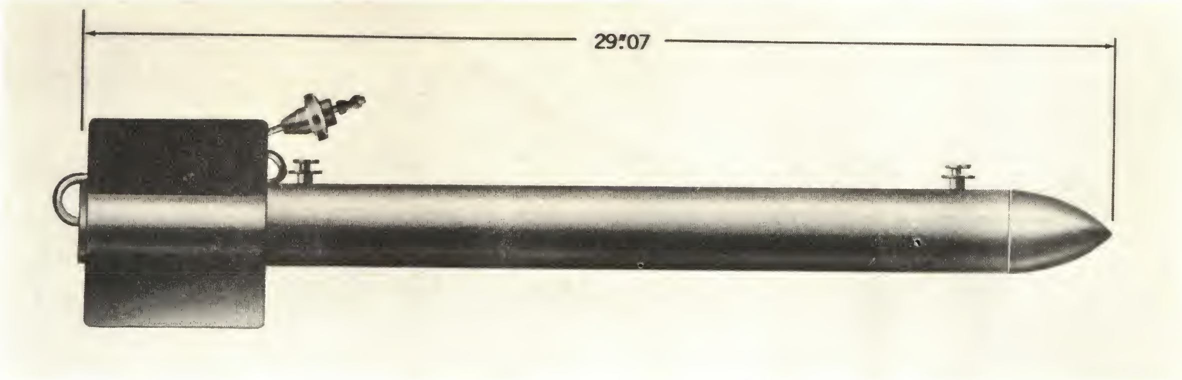


Figure 5–2. 2.25-Inch Rocket Mk 6 Mod 0 (SCAR), External View.

Mark	6
Mod	0
Nominal Velocity (fps)	1110
Nominal Weight (lb)	12.46
Overall Length (in.)	29.07
Head, 2.25-Inch, Mk-Mod	3–0, 2, or 3
Motor, 2.25-Inch, Mk-Mod	16–4, 5, or 6
Nose Fuze Mk-Mod	None
Base Fuze Mk-Mod	None
Time to 1000 yd (sec.) (Temperature at 70° F)	3.2
C.G., Before Burning (in.) (Measured from rear)	12.85
Trajectory Table in OP No.	1829
Container Mk-Mod	2–0

Special Information

This round simulates trajectories of the 5.0-Inch HVAR Rocket.

2.75-INCH ROCKET MK 2 MODS 0 AND 1 (HE-FFAR)

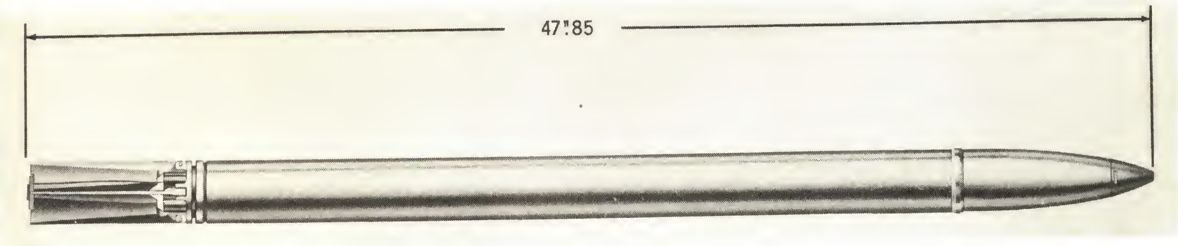


Figure 5–3. 2.75-Inch Rocket Mk 2 Mod 1 (HE-FFAR), Ready for Firing.

Mark	2	2
Mod	0	1
Lot No. Prefix	RTCA	RTCA
Nominal Weight (lb)	17.99	17.99
Overall Length (in.)	47.85	47.85
Warhead Mk-Mod	1–1, 3, 4, or 5	1–1, 3, 4, or 5
Warhead Type	HE	HE
Motor Mk-Mod	1–3 or 4	1–3 or 4
Nose Fuze Mk-Mod	176–0 or 1	178–0, 1, or 2
Burnt Velocity (fps)	2300	2300
Time to 1000 yd (sec.) (Temperature at 70° F)	2.2	2.2
C.G., Before Burning (in.) (Measured from Nose)	19.50	19.50
C.G., After Burning (in.) (Measured from Nose)	15.90	15.90
Trajectory Table in OP No.	1998	1998

Special Information

The difference in the mods lies in the selection of the fuze. Fuze Mk 176, used with the Mod 0 rocket, has a delay element; Fuze Mk 178, used with the Mod 1 rocket, fires instantaneously.

2.75-INCH ROCKET MK 3 MOD 0 (HEAT-FFAR)

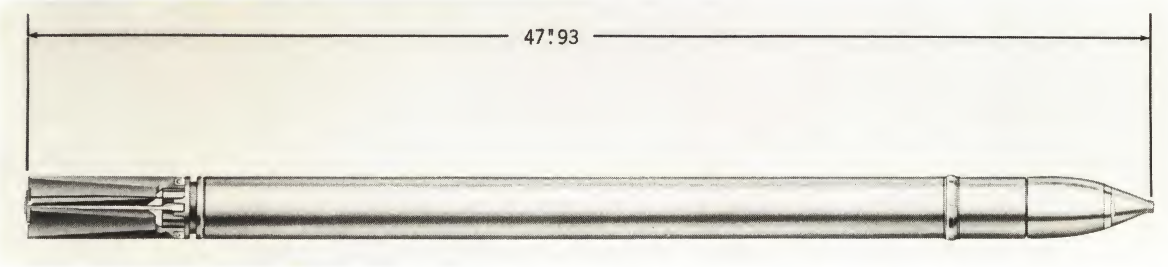


Figure 5–4. 2.75-Inch Rocket Mk 3 Mod 0 (HEAT-FFAR), Ready for Firing.

Mark	3
Mod	0
Lot No. Prefix	RTCD
Nominal Weight (lb)	18.12
Overall Length (in.)	47.93
Warhead Mk-Mod	5–0
Warhead Type	HEAT
Motor Mk-Mod	1–3 or 4
Nose Fuze Mk-Mod	181–0
Burnt Velocity (fps)	2300
Trajectory Table in OP No.	1998

Special Information

With its shaped-charge explosive in the warhead, the 2.75-Inch Rocket Mk 3 Mod 0 is designed for penetration of light armor or other fortifications.

2.75-INCH ROCKET MK 4 MODS 0 AND 1 (HE-FFAR)

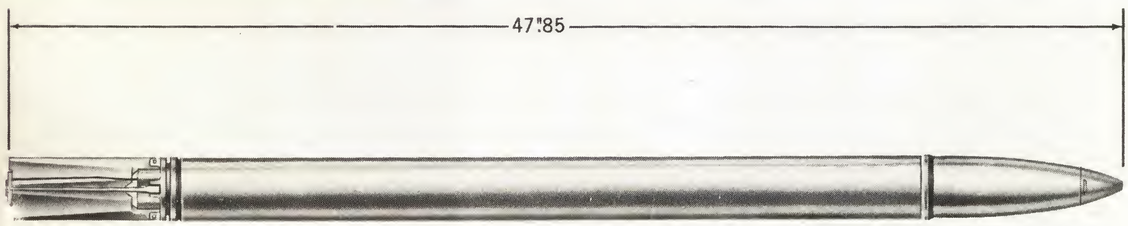


Figure 5–5. 2.75-Inch Rocket Mk 4 Mod 1 (HE-FFAR), Ready for Firing.

Mark	4	4
Mod	0	1
Lot No. Prefix	RTCA	RTCA
Nominal Weight (lb)	17.79	17.79
Overall Length (in.)	47.85	47.85
Warhead Mk-Mod	1–1, 3, 4, or 5	1–1, 3, 4, or 5
Warhead Type	HE	HE
Motor Mk-Mod	2–0, 1, 2, or 3	2–0, 1, 2, or 3
Nose Fuze Mk-Mod	176–0 or 1	178–0, 1, or 2
Burnt Velocity (fps)	2300	2300
Time to 1000 yd (sec.) (Temperature at 70° F)	2.2	2.2
C.G., Before Burning (in.) (Measured from Nose)	19.50	19.50
C.G., After Burning (in.) (Measured from Nose)	15.90	15.90
Trajectory Table in OP No.	1998	1998

Special Information

The difference in the mods lies in the selection of the fuze. Fuze Mk 176, used with the Mod 0 rocket, has a delay element; Fuze Mk 178, used with the Mod 1 rocket, fires instantaneously.

2.75-INCH ROCKET MK 5 MOD 0 (HEAT-FFAR)

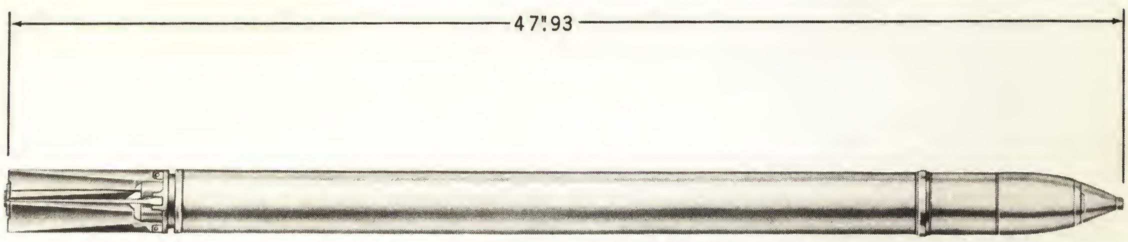


Figure 5–6. 2.75-Inch Rocket Mk 5 Mod 0 (HEAT-FFAR), Ready for Firing.

Mark	5
Mod	0
Lot No. Prefix	RTCD
Nominal Weight (lb)	17.92
Overall Length (in.)	47.93
Warhead Mk-Mod	5–0
Warhead Type	HEAT
Motor Mk-Mod	2–0, 1, 2, or 3
Nose Fuze Mk-Mod	181–0
Burnt Velocity (fps)	2300
Trajectory Table in OP No.	1998

Special Information

The 2.75-Inch Rocket Mk 5 Mod 0 is used against a variety of targets, including light armor, which are to be penetrated by a jet of high-temperature gases.

2.75-INCH ROCKET MK 6 MODS 0 AND 1 (HE-FFAR)

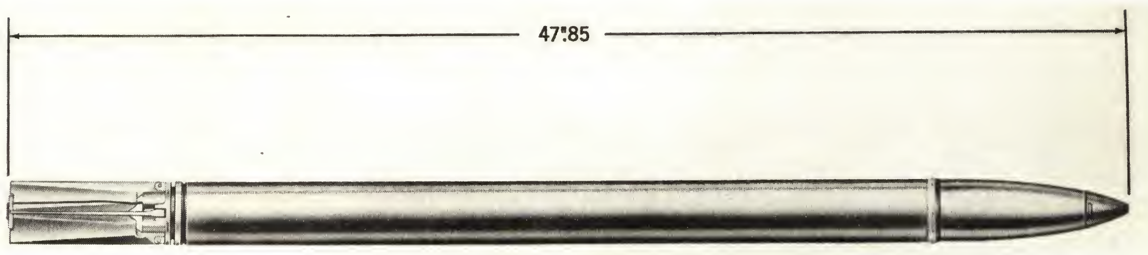


Figure 5–7. 2.75-Inch Rocket Mk 6 Mod 1 (HE-FFAR), Ready for Firing.

Mark	6	6
Mod	0	1
Lot No. Prefix	RTCA	RTCA
Nominal Weight (lb)	17.92	17.92
Overall Length (in.)	47.85	47.85
Warhead Mk-Mod	1–1, 3, 4, or 5	1–1, 3, 4, or 5
Warhead Type	HE	HE
Motor Mk-Mod	3–0, 1, 2, or 3	3–0, 1, 2, or 3
Nose Fuze Mk-Mod	176–0 or 1	178–0, 1, or 2
Burnt Velocity (fps)	2300	2300
Time to 1000 yd (sec.) (Temperature at 70° F)	2.2	2.2
Trajectory Table in OP No.	1998	1998

Special Information

The difference in the mods lies in the difference in the fuzes. Fuze Mk 176, used with Rocket Mod 0, has a delay element; Fuze Mk 178, used with Rocket Mod 1, fires instantaneously.

2.75-INCH ROCKET MK 7 MOD 0 (HEAT-FFAR)

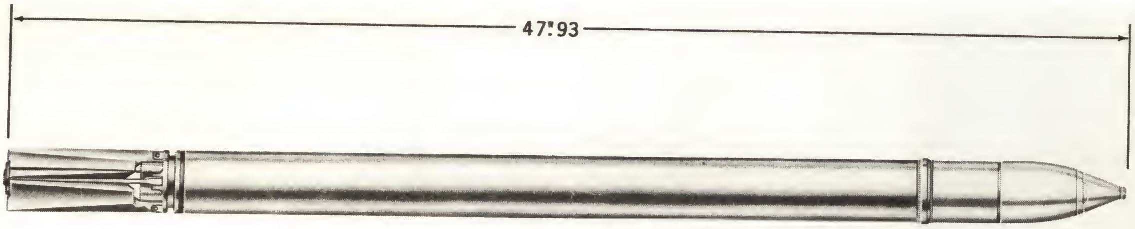


Figure 5–8. 2.75-Inch Rocket Mk 7 Mod 0 (HEAT-FFAR), Ready for Firing.

Mark	7
Mod	0
Lot No. Prefix	RTCD
Nominal Weight (lb)	17.92
Overall Length (in.)	47.93
Warhead Mk-Mod	5–0
Warhead Type	HEAT
Motor Mk-Mod	3–0, 1, 2, or 3
Nose Fuze Mk-Mod	181–0
Burnt Velocity (fps)	2300
Trajectory Table in OP No.	1998

Special Information

This round is employed against lightly fortified targets which are to be penetrated by a jet of high-temperature gases.

2.75-INCH ROCKET MK 8 MOD 0 (A/A–HE), AND MK 8 MOD 1 (A/G–HE)

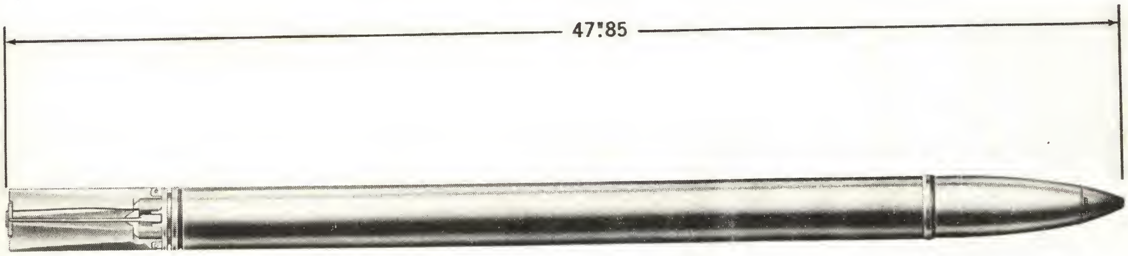


Figure 5–9. 2.75-Inch Rocket Mk 8 Mod 0 (A/A, HE), and Mk 8 Mod 1 (A/G, HE), Ready for Firing.

Mark	8
Mod	0
Lot No. Prefix	RTCB
Nominal Weight (lb)	17.79
Overall Length (in.)	47.85
Warhead Mk-Mod	1–1, 3, 4, or 5
Warhead Type	HE
Motor Mk-Mod	2–0, 1, 2, or 3
Nose Plug Drawing No.	456924
Burnt Velocity (fps)	2300
Time to 1000 yd (sec.) (Temperature at 70° F)	2.2
Trajectory Table in OP No.	1998
Fuze Mk 176 Mods 0 and 1	(A/A)
Fuze Mk 178 Mod 0	(A/G)

2.75-INCH ROCKET MK 9 MOD 0 (A/G–HEAT)

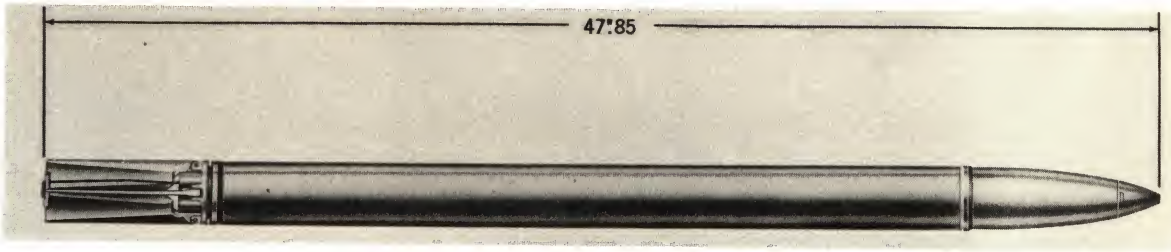


Figure 5–10. 2.75-Inch Rocket Mk 9 Mod 0 (A/G, HEAT), Ready for Firing.

Mark	9
Mod	0
Lot No. Prefix	RTCB
Nominal Weight (lb)	17.92
Overall Length (in.)	47.85
Warhead Mk-Mod	5–0
Warhead Type	(A/G–HE)
Motor Mk-Mod	3–0, 1, 2, or 3
Nose Plug Drawing No.	456924
Burnt Velocity (fps)	2300
Time to 1000 yd (sec.) (Temperature at 70° F)	2.2
Trajectory Table in OP No.	1998
Fuze Mk and Mod	181–0

5.0-INCH ROCKET MK 28 MOD 4 (GP, HVAR) AND MOD 5 (VT, HVAR)

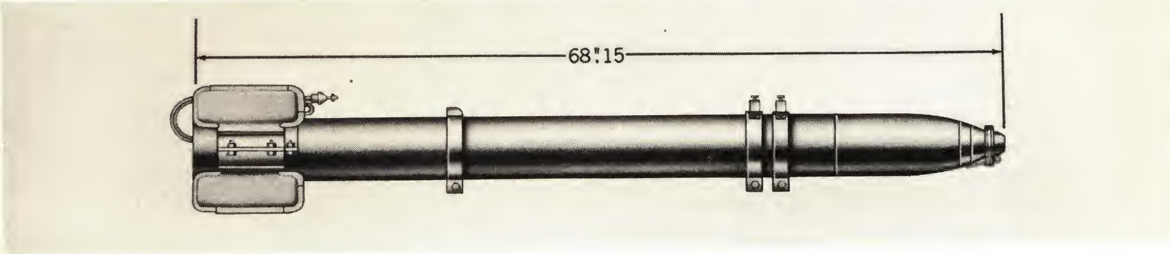


Figure 5–11. 5.0-Inch Rocket Mk 28 Mod 4 (GP, HVAR), External View.

Warhead Type	GP	VT
Mark	28	28
Mod	4	5
General Arrangement	655884	
List of Drawings	174575	
Nominal Velocity (fps)	1325	1325
Nominal Weight (lb)	138.49	138.49
Overall Length (in.)	68.15	69.68
Warhead, 5.0-Inch, Mk-Mod	6–1	6–4
Motor, 5.0-Inch, Mk-Mod	10–6	10–6
Nose Fuze Mk-Mod	149–0 or 1	172–2
Auxiliary Booster Mk-Mod	3–1	None
Base Fuze Mk-Mod	164–0	164–0
Time to 1000 yd (sec.) (Temperature at 70° F)	2.8	2.8
C.G., Before Burning (in.) (Measured from rear)	34.27	34.27
C.G., After Burning (in.) (Measured from rear)	35.87	35.87
Trajectory Table in OP No.	1829	1829

Special Information

These rounds are fired from aircraft, primarily against surface targets. With its impact-firing fuzes, the Mod 4 is used against shipping convoys, tanks, and gun emplacements. The Mod 5, which has a VT fuze, is employed against light equipment and personnel.

5.0-INCH ROCKET MK 32 MOD 1 (HEAT, HVAR)

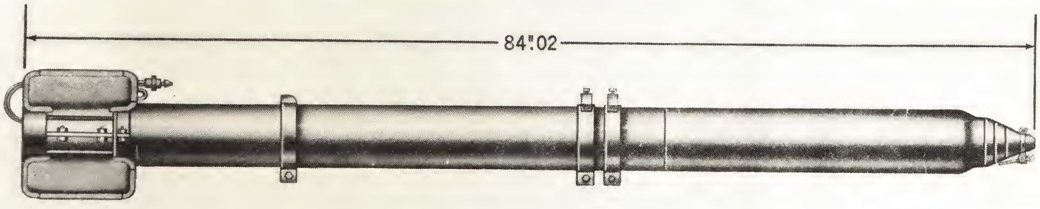


Figure 5–12. 5.0-Inch Rocket Mk 32 Mod 1 (HEAT, HVAR), External View.

Mark	32
Mod	1
Nominal Velocity (fps)	1325
Nominal Weight (lb)	140.47
Overall Length (in.)	84.02
Warhead, 5.0-Inch, Mk-Mod	25–1 or 2
Motor, 5.0-Inch, Mk-Mod	10–6
Nose Fuze Mk-Mod	149–0 or 1
Base Fuze Mk-Mod	None
Time to 1000 yd (sec.) (Temperature at 70° F)	2.8
Trajectory Table in OP No.	1829

Special Information

With the shaped-charge explosive in the warhead of this round, the rocket is effective against a broad range of surface targets, such as tanks, heavily armored fortifications, and truck convoys. The high-temperature jet of the shaped charge assures deep penetration of armor, while the large number of fragments causes widespread damage to lighter targets.

5.0-INCH ROCKET MK 34 MOD 0 (AP/ASW, HVAR)

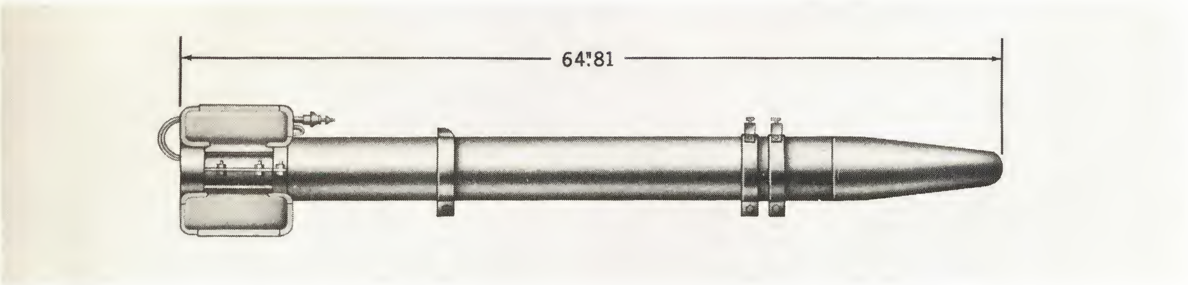


Figure 5–13. 5.0-Inch Rocket Mk 34 Mod 0 (AP/ASW, HVAR), External View.

Mark	34
Mod	0
Nominal Velocity (fps)	1325
Nominal Weight (lb)	138.43
Overall Length (in.)	64.81
Warhead, 5.0-Inch, Mk-Mod	29–0
Motor, 5.0-Inch, Mk-Mod	10–6
Nose Fuze Mk-Mod	None
Base Fuze Mk-Mod	None (plugged)
Time to 1000 yd (sec.)	2.8
Trajectory Table in OP No.	1829

Special Information

This round is designed for use against underwater targets, particularly submarines.

5.0-INCH ROCKET MK 35 MOD 0 (AP, HVAR)

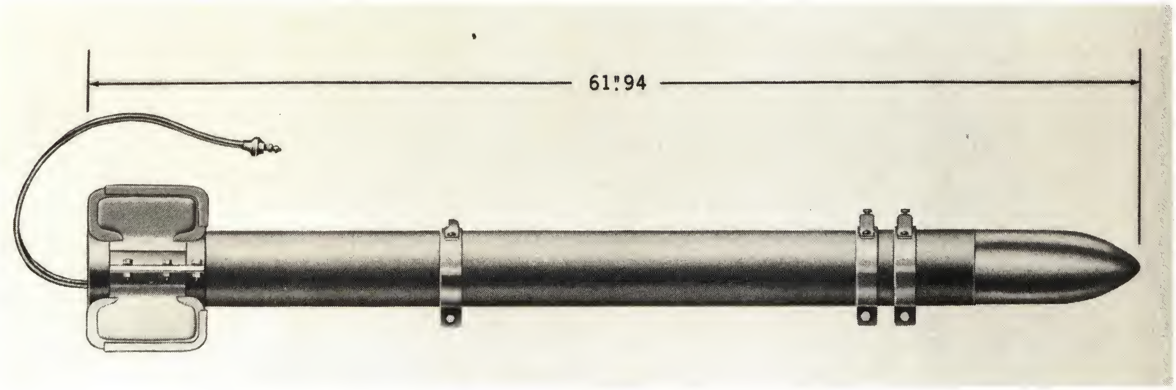


Figure 5–14. 5.0-Inch Rocket Mk 35 Mod 0 (AP, HVAR), External View.

Mark	35
Mod	0
Overall Length (in.)	61.94
Nominal Weight (lb)	138.17
Warhead, 5.0-Inch, Mk-Mod	2–2
Motor, 5.0-Inch, Mk-Mod	10–6
Nose Fuze Mk-Mod	None
Base Fuze Mk-Mod	166–0 or 2
Nominal Velocity (fps)	1325
Time to 1000 yd (sec.) (Temperature at 70° F)	2.8
Trajectory Table in OP No.	1829

Special Information

This round is employed against surface targets, such as medium armored ships or tanks, convoys, or protected gun emplacements.

5.0-INCH ROCKET MK 36 MOD 0 (SMOKE-PWP, HVAR)

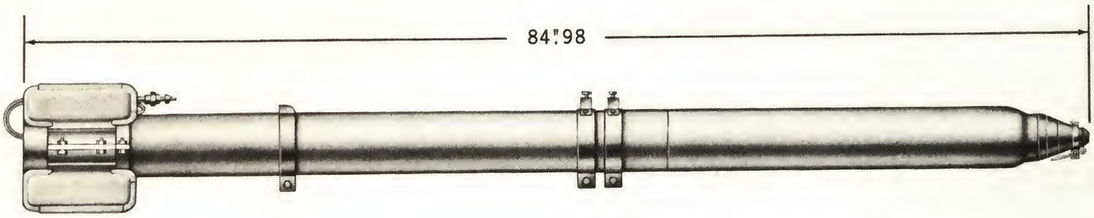


Figure 5–15. 5.0-Inch Rocket Mk 36 Mod 0 (SMOKE-PWP, HVAR), External View.

Mark	36
Mod	0
Overall Length (in.)	84.98
Nominal Weight (lb)	140.71
Warhead, 5.0-Inch, Mk-Mod	4–1
Motor, 5.0-Inch, Mk-Mod	10–6
Nose Fuze Mk-Mod	149–0 or 1
Base Fuze Mk-Mod	None
Nominal Velocity (fps)	1325
Time to 1000 yd (sec.) (Temperature at 70° F)	2.8
Trajectory Table in OP No.	1829

Special Information

This round is employed for marking surface targets or for filling holes in a smoke screen.

5.0-INCH ROCKET MK 39 MOD 0 (PRAC, HVAR)

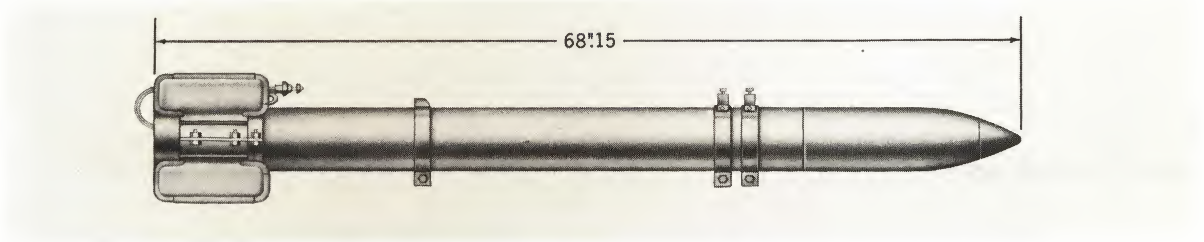


Figure 5–16. 5.0-Inch Rocket Mk 39 Mod 0 (PRAC, HVAR), External View.

Mark	39
Mod	0
Overall Length (in.)	68.15
Nominal Weight (lb)	138.37
Head, 5.0-Inch, Mk-Mod (Inert Loaded)	6–1
Motor, 5.0-Inch, Mk-Mod	10–6
Dummy Nose Fuze	1211969
Base Fuze Hole Plug	656614
Nominal Velocity (fps)	1325
Time to 1000 yd (sec.) (Temperature at 70° F)	2.8
Trajectory Table in OP No.	1829

Special Information

This rocket is the practice round for 5.0-inch high-velocity aircraft rockets. In the head, a dummy nose fuze and a base fuze hole plug are used to replace the nose fuze and base fuze, respectively.

5.0-INCH FOLDING-FIN AIRCRAFT ROCKET (ZUNI) MK 40 MODS 0 AND 1

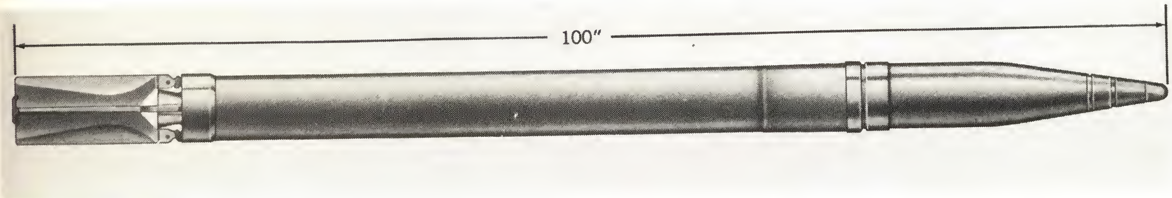


Figure 5–17. 5.0-Inch Folding-Fin Aircraft Rocket (ZUNI) Mk 40 Mod 1, Ready for Firing.

Warhead Type	GP	VT
Mark	40	40
Mod	0	1
Nominal Weight (lb) (approx)	107	107
Overall Length (in.) (approx)	100	100
Warhead Mk-Mod	24–0	24–0
Warhead Type	HE	HE
Nose Fuze Mk-Mod	188–0	T2061
Base Fuze Mk-Mod	191–0	191–0
Burnt Velocity (fps)	2370	2370

Special Information

These rounds are aircraft-fired primarily against surface targets. The Mod numbers are determined by the use of either impact detonating or VT fuzes. The Mod 0 is used against shipping, tanks, and gun emplacements. The Mod 1, equipped with a VT fuze, is employed against light equipment, fortifications, and personnel. These rounds may be ripple- or single-fired from four-round launcher packages.

5.0-INCH FOLDING-FIN AIRCRAFT ROCKET (ZUNI) (ATAP), MK 41 MODS 0 AND 1

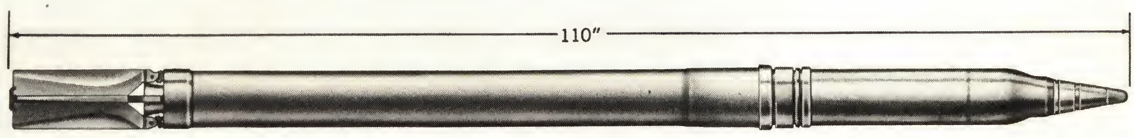


Figure 5–18. 5.0-Inch Folding-Fin Aircraft Rocket (ZUNI) Mk 41 Mod 1, Ready for Firing.

Warhead Type	GP	VT
Mark	41	41
Mod	0	1
Nominal Weight (lb) (approx)	107	107
Overall Length (in.) (approx)	110	110
Warhead Mk-Mod	32–0	32–0
Warhead Type	ATAP	ATAP
Nose Fuze Mk-Mod	188–0	T2061
Base Fuze Mk-Mod	None	None
Burnt Velocity (fps)	2370	2370

Special Information

The shaped-charge explosive in the warhead of this round provides it with unusual tactical flexibility. Fuzed with Point-Detonating Fuze Mk 188, it is effective against a number of surface targets such as tanks, heavily-armored fortifications, and vehicles of all types. The Mod 1, with its VT fuze, is an effective air-to-air weapon. These rounds may be ripple- or single-fired from four-round launcher packages.

Chapter 6

ASSEMBLY AND DISASSEMBLY OF COMPLETE ROUNDS

General

This chapter describes the wrenches, procedures, and precautions to be used in assembly and disassembly operations.

5-Inch Utility Spanner Wrench, BuOrd Dwg 592882 Rev. A. This steel wrench is used on 5-inch heads and on the 5-inch head and motor shipping caps which are recessed to receive the pin of the wrench. The rectangular hole in the handle of the wrench fits the flats of nose shipping plugs.

Fuze Wrench, BuOrd Sk 124784. This steel wrench fits the flats on the ogive of Nose Fuze Mk 149 All Mods.

Figure 6–1. 5-Inch Utility Spanner Wrench (592882-A).

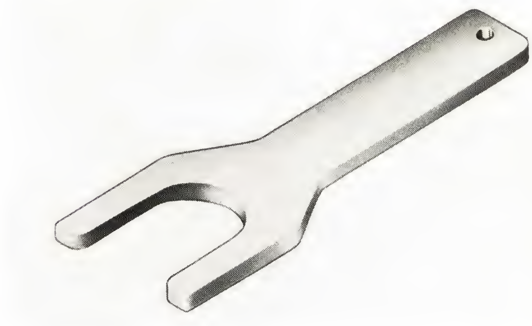


Figure 6–2. Fuze Wrench (Sk 124784).

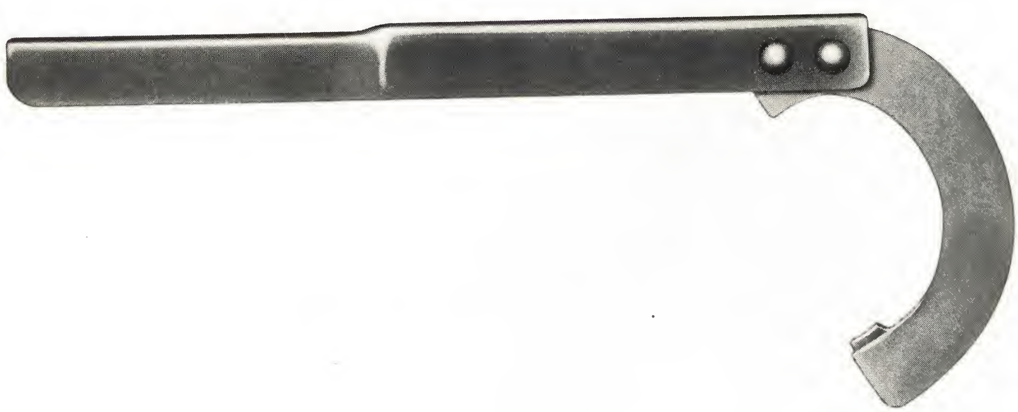


Figure 6–3. Fuze Wrench M–17.

Fuze Wrench M–17. This steel wrench (Army Drawing 73–3B1–1) fits the lugs on the body of VT Fuze Mk 172 All Mods.

2.25-Inch Subcaliber Practice Rockets

Assembly Procedure. After the rocket components have been removed from their containers and inspected, assemble as follows:

1. Remove the front shipping caps from the motor.
2. Lute the threads of both head and motor with a suitable luting compound, such as Crater compound, or red or white lead of such consistency that it can be applied with a brush.
3. Thread the head into the motor as tightly as possible, using a Stillson-type

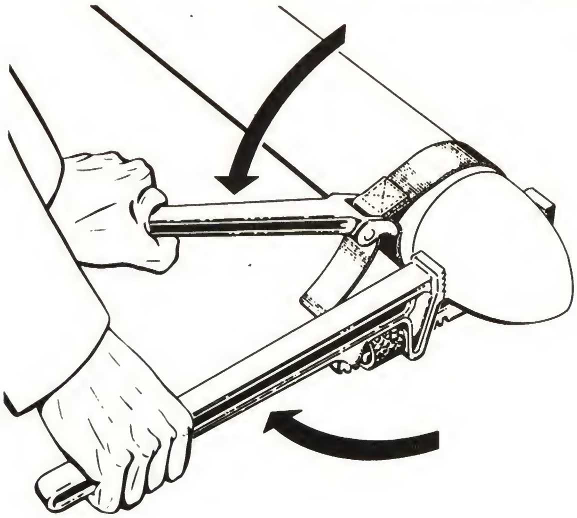


Figure 6–4. Assembling Head and Motor of 2.25-Inch SCAR Rocket.

wrench on the head and a strap wrench ONLY on the motor, figure 6–4.

4. Place the cable of the electrical connector across the inboard side of the outboard (in relation to the plane's fuselage) slit fin, figure 6–5.

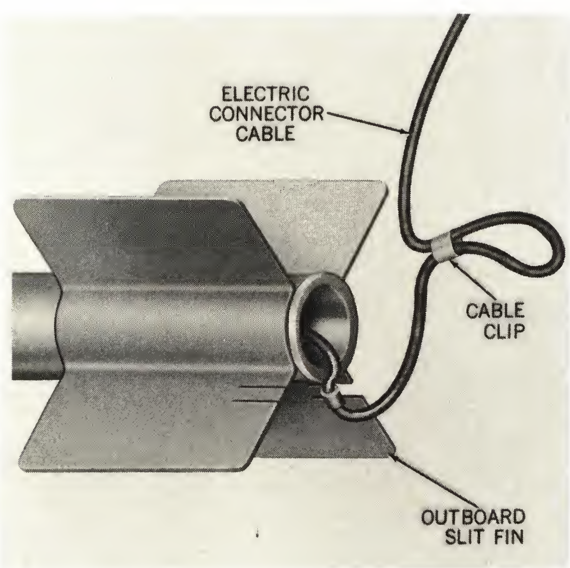


Figure 6—5. Electrical Connector Cable Snubbed to Fin of 2.25-Inch Rocket.

5. Bend the 3/8-inch strip of metal, between the slits, lightly over the cable.

6. Remove all slack in the cable between the nozzle and the slit fin.

7. Secure the cable to the slit fin by bending the strip tightly over the cable. Take care to avoid bending any other part of this fin or the other fins.

8. The clip which forms the loop in the cable may be removed, if necessary, to lengthen the cable and make it fit certain launchers. Otherwise, leave this clip on the cable because it prevents the cable from whipping around in the air stream. This whipping action might loosen one of its connections or damage the wing surface of the aircraft.

9. See that the shorting clip is in place on the electrical connector plug.

Disassembly Procedure. Inspect the round for defects before disassembling as follows:

1. Be sure that the shorting clip is in place on the electrical connector plug.

2. Unscrew the head from the motor, using a Stillson-type wrench on the head and a strap wrench on the motor.

3. Wipe the luting compound from the threads of the head and motor, using an approved solvent.

4. Replace the front shipping cap on the motor.

5. Return the head and motor to their container.

5.0-Inch High-Velocity Rockets

Assembly Procedure.

NOTE: Illustrations of most of the steps in assembling these rockets are in the section on assembly and disassembly of complete rounds in chapter 1.

1. Place motor in clamps or assembly rack.

2. Position and secure the suspension bands to fit the launcher which will fire the round. Suspension bands are loosened or secured by tightening the bolts which clamp the bands to the motor tube.

3. Slip the fin assembly over the nozzle end of the motor tube so that it interlocks

with projections on the rear lug supporting band, figure 1–25.

4. Secure the fin assembly by tightening bolts into the nuts which are brazed to the fin assembly sleeve.

5. Remove the shipping cap from the forward end of the motor tube. Do not remove the felt washer that is located forward of the front closure disc.

6. Remove the shipping cap from the base of the rocket warhead.

7. Inspect to insure that a base fuze, gas-checked, or a base fuze hole plug, gas-checked, has been properly installed in AP/ASW Warhead Mk 29.

8. Screw the warhead into the motor, using the 5-inch Utility Spanner Wrench to set the warhead, figure 1–18.

9. Remove the rear shipping cap from the motor.

CAUTION: Do not remove the shorting clip on the electrical connector plug at this time.

10. Remove the shipping plug from the nose of the warhead. See that the auxiliary booster does not fall out.

11. Install the nose fuze. If the nose fuze is the Mk 149, insert and seat it, as shown in figure 1–19. Tighten with Fuze Wrench, Sk 124784. If the nose fuze is the VT Mk 172, figure 4–3, proceed as follows:

a. Pull out the rear safety pin; then reinsert it. If the pin does not insert easily, the fuze should be considered hazardous and disposed of accordingly. If it does insert easily, pull the pin out again.

b. Insert the fuze in the cavity and screw the threads into the warhead tightly with Fuze Wrench M–17.

12. Remove assembled rocket from clamps or rack.

13. After the Mk 172-fuzed rocket is loaded on the launcher, install the arming wire in the fuze as follows:

a. Remove the seal wire.

b. Insert the arming wire in the hole where the seal wire was located, inboard hole of the arming pin. It may be necessary to move the arming pin to another hole in the ring in order to line up the arming pin with the arming wire. In moving the arming pin to another hole, take care to avoid turning the arming vanes.

c. The end of the arming wire should extend 3 to 4 inches beyond the forward end of the fuze. DO NOT USE FAHNESTOCK CLIPS; they might foul the arming vanes. Sufficient tension is provided by the arming pin spring to hold the arming wire securely in place.

d. Remove the cotter pin after the arming wire has been properly installed.

Disassembly Procedure.

1. Be sure that the shorting clip is in place on the electrical connector plug and that the safety wire is in place on the fuze.

2. Place rocket motor in clamps or assembly rack.

3. Unscrew the nose fuze with the proper fuze wrench. See that the auxiliary booster does not fall out.

4. Return the fuze to the container and reseal the container. If the fuze is Nose (VT) Fuze Mk 172, make the test with the rear safety pin as in step 11 (a) of the assembly procedure before returning the fuze to its container.

5. Screw the shipping plug into the nose of the warhead.

6. Unscrew the warhead from the motor with a 5-Inch Utility Spanner Wrench.

7. Check the base fuze to see that it is secure; then screw the rear shipping cap on the warhead.

8. Return the warhead to the container.

9. Replace the rear shipping cap on the motor.

10. Be sure that the felt washer is in place on the forward end of the motor; then screw on the shipping cap.

11. Loosen the bolts securing the fin assembly sleeve to the motor tube.

12. Slide the fin assembly off of the nozzle end of the motor tube.

13. Inspect the fin assembly for bends or other damage. If none is present, or

after repairs are made, return the fin assembly to its container.

14. Tape the electrical connector to the motor tube.

15. Return the motor to its container, being careful not to place any strain on the electrical connector cable or plug.

Assembly and Disassembly of Folding-Fin Aircraft Rockets

Assembly or disassembly of folding-fin aircraft rockets consists only of joining the rocket warhead, fuzed on the 2.75-inch FFAR only, to the motor. However, the hazards described for other rockets during these operations exist here as well. Folding-fin rockets generally are distinguished from other rockets by their containers and, in some cases, by their rocket warheads and the means of attaching these warheads to the rocket motor. The resultant peculiarities of assembly and disassembly procedures are described in detail in the following paragraphs.

Assembly and Disassembly of 2.75-Inch Folding-Fin Aircraft Rocket

The assembly procedure for this rocket is distinguished by its method of warhead-motor attachment and by its warhead, which is issued with the nose fuze installed. Fuzes for these rockets are not separate items of issue. The assembly procedure is determined by the type of motor used with the affected rocket. In order to resist the torque applied during rocket assembly without twisting the lockwire which secures the warhead closure to the rocket motor tube, some motor tubes are dimpled into the warhead closure slots. This dimpling is done at the depots on all new or reworked rocket motors prior to shipment or issue. However, pending the availability of dimpled motors, undimpled motors may be used if assembled as follows:

When issued in the four-round Container Mk 1, figure 1–20, the nose end of the fuzed warhead is seated in a head shipping support in the forward end of the rocket motor. Assemble rockets received in this manner as described in the following paragraphs.

Assembly of Undimpled Motors and Warheads

Remove the warhead and the head shipping support from the motor. The shipping support is snap-fitted to the head closure in the motor. On some motors, there is a rubber gasket ring under the lip of the head shipping support and a shim between the head shipping support and the head closure. Remove and dispose of the shim and gasket before threading the warhead to the motor.

Hold the motor tube with a strap wrench or a soft-jaw vise that will not mark or deform the tube. Deformed tubes shall be reported for disposition. Figure 6–6 describes a wrench, which may be fabricated locally, used to grip the motor tube and facilitate assembly. The motor should be held within only the forward 2½ inches in order to be in the area supported by the head closure assembly.

Using another strap wrench on the warhead or a wrench on the fuze, tighten the warhead as tightly as possible without causing the head closure to turn and force the visible lockwire in or out of the elongated hole in the motor tube lockwire groove. Movement of this tab within the confines of the elongated hole is normal. Figure 6–7 shows the motor tube and lockwire slot.

> CAUTION: Do not pull the lockwire tab down and out of the elongated hole into the motor tube lockwire groove. The enlarged tab traveling through the lockwire groove will bulge the motor tube, making it unsafe to fire. Any motors with the lockwire tab displaced either by turning in or out of the elongated groove should be discarded as unserviceable. If a gap exists between the forward end of the motor and the warhead after assembly, discard the rocket as unserviceable.

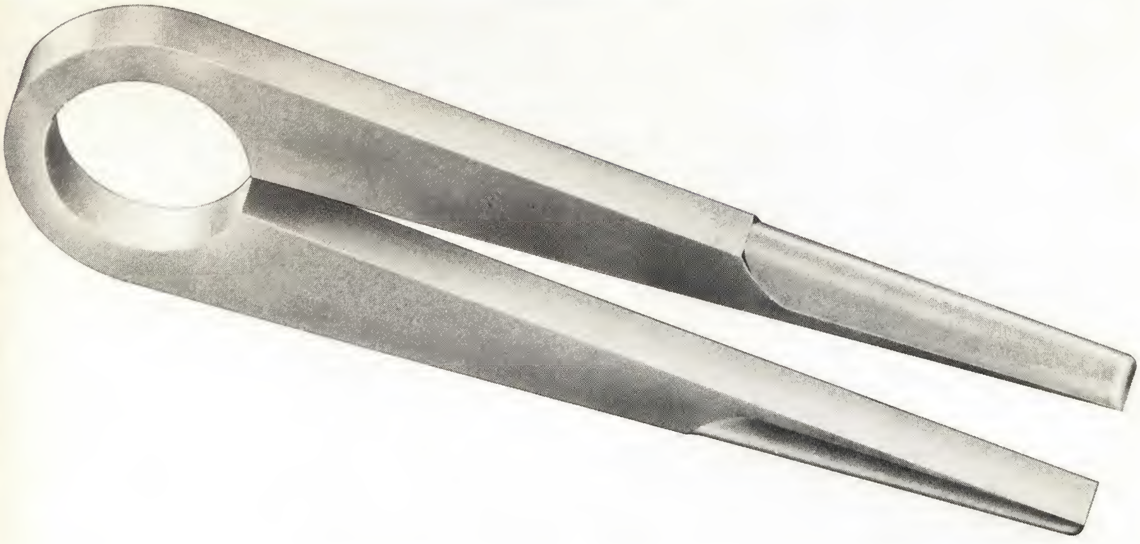


Figure 6–6. 2.75-Inch Rocket Spanner Wrench.

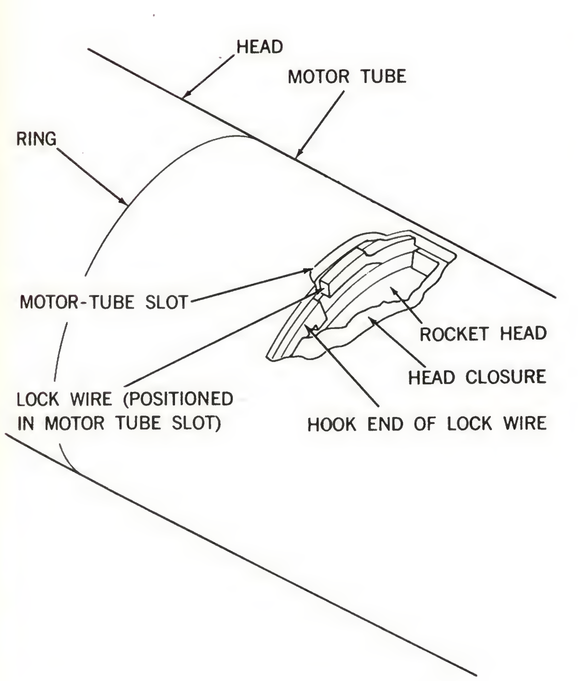


Figure 6–7. 2.75-Inch Rocket Motor Tube Lockwire Slot, Cutaway View.

All rockets returned from a flight also will be tightened as described, prior to the next flight.

Assembly of Dimpled Motor Tubes and Warheads

The assembly procedure for this configuration of rocket motor follows that shown above for undimpled rocket motors except for the method of tightening the rocket warhead.

Using another strap wrench on the warhead or a fuze wrench, tighten the warhead as much as possible without turning the head closure, which would deform the motor tube dimples or force the lockwire into or out of the elongated hole in the tube. Motor tubes whose dimples have been inadvertently straightened may be used if the lockwire tab has not been forced into or out of the elongated hole in the motor tube, and if examination shows no cracks or other motor tube damage.

Activities which have access to a torque wrench and are properly equipped should fabricate a torque-wrench nose fuze, figure 6–8. Using this adapter, apply 55 ft/lbs of torque to tighten the warhead. Properly made dimples will resist 80 ft/lbs of torque. If a gap exists between the forward end of the motor and the warhead after assembly, discard the rocket as unserviceable.

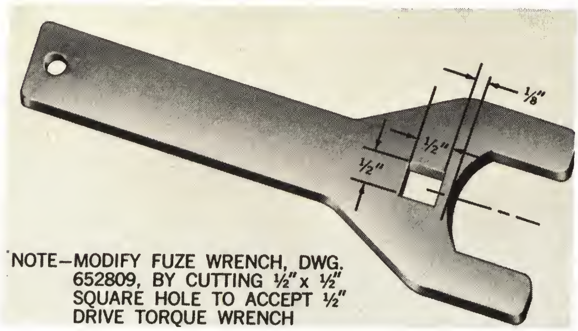


Figure 6–8. Modified Torque Wrench.

Inspect the rockets for marks, scores, abrasions, deformation of the motor tube, or gap between the warhead and motor. Discard as unserviceable any rocket with these defects.

All rockets, if returned from a previous flight, also will be tightened, as described, prior to the next flight.

Remember that the fin protector contains a spring that serves to short circuit the igniter leads. Do not remove the fin protector until just prior to loading the round in the launcher.

When rocket motors are issued in the Aero 6A Aircraft Rocket Launcher Package, see chapter 7, no head shipping support is included because the warheads are in a separate container, figure 1–19. Normally, it is not necessary to remove motors from such containers to assemble warheads.

If the motor turns in the launcher container while the warhead is being screwed on, pull the motor out of the launcher far enough to obtain a hand. DO NOT hold the fin assembly to prevent the motor's turning. To pull a motor out of the Aero 6A launcher container, turn the motor in the direction to tighten the warhead and pull forward. This clockwise twisting causes a lug on a fin hinge to engage a low angle cam on the side of the detent in the container tube. The cam drives the detent to the side and releases the rocket.

The procedure for assembly of undimpled warheads and motors requires at least partial removal of the rockets from their launcher. If difficulty is encountered in removing the rockets from the launcher, another launcher should be used. Some launcher detents may stick, and excessive torque applied to the rocket to cam the detent up may damage the detent or turn the lockwire in the nozzle end of the motor.

After assembling the warhead, replace the rocket in the container tube. Make certain that the fins straddle the detent in the tube before pushing the motor into the tube. If a fin is not on either side of the detent, the motor may slide past the detent and damage the ignition system. Push the rocket into the tube with firm pressure until the detent snaps into the groove on the nozzle plate. Make certain that the detent is properly latched by pulling forward on the motor. The detent should hold the motor firmly.

Rockets shipped in Aero 7D Aircraft Rocket Launcher Packages are received and stored completely assembled. Directions for their use are provided in chapter 7. However, rockets shipped in this launcher package have reportedly become undetented during shipment. Prior to issuance or use, a detent inspection is necessary. This inspection is accomplished by removing the launcher package end pans and pushing forward, gently but firmly, on the fin retainer of each rocket. If a rocket moves forward when pushed, its detent is unlatched. To relatch the rocket, push aft gently but firmly on the rocket warhead until the detent snaps into the rocket detent groove. Retest as described to see that the detent holds.

When opening a launcher to assemble a warhead, check to be sure it contains the proper warhead. Check rocket detent in the launcher-tube below deck, if practicable. It is HAZARDOUS to touch or be in close proximity to the loaded launcher tubes when the launchers are in an electromagnetic field. If it becomes necessary to perform these operations on the flight deck, the provisions of BuShips Messages 232230Z May 1958 should be observed. However, if practicable, avoid rockets in the launcher while on the flight deck. To perform detent in-

spection under these conditions, use a non-conductive plastic rod 12 inches or more in length to push the rockets.

Rocket motors and warheads received in other containers may be assembled and loaded in the Aero 6A launcher package. In this case, the warheads may be assembled with the motors prior to being placed in the launcher-container, or the warheads may be assembled after the motors are positioned in the launcher-container. Fin protectors and head shipping supports must be removed from motors received in other containers before they are loaded in this type of launcher-container.

Disassembly

After installing the fin protector over the after end of the motor and fins, unscrew the warhead from the motor BY HAND.

Do not remove the fuze from the warhead. Lightly grease the threads of the warhead to prevent corrosion and return the warhead to stowage.

Install the head shipping support, if supplied, in the head closure of the motor and return the motor to stowage.

Assembly and Disassembly of 5.0-Inch Folding-Fin Aircraft Rocket (ZUNI)

Assembly instructions for the ZUNI follow those provided for both the 5.0-inch HVAR and the 2.75-inch FFAR. The rocket motor used with the ZUNI (see chapter 3), although it incorporates the same tube-rupturing safety feature found on the 2.75-inch FFAR, does not require a separate head closure. The 2.75-inch rocket motor tube requires a separate, threaded head closure which is lockwired to the motor tube. The ZUNI motor is thicker at the ends, permitting built-in head closure. Instructions for installing ZUNI motors in the Aero 10D Rocket Launcher Package are provided in chapter 7.

Like the 2.75-inch FFAR, used with the Aero 6A launcher package (see chapter 7), ZUNI rocket warheads are installed on the motors after the launcher is mounted on the aircraft. Instructions for ZUNI rocket warhead assembly and disassembly are provided in the section of chapter 7 covering the Aero 10D Rocket Launcher Package. ZUNI rockets are not shipped assembled, however, nor are their warheads and nose fuzes treated as single items of issue. ZUNI fuzing, as with the 5.0-inch HVAR, is performed as part of the pre-takeoff armament procedure. Fuzing instructions provided for the 5.0-inch HVAR also pertain to the ZUNI.

Precautionary measures prescribed for the 5.0-inch HVAR and the 2.75-inch FFAR also apply to ZUNI.

Chapter 7

AIRCRAFT ROCKET LAUNCHER PACKAGES

General

Aircraft rocket launcher packages are aluminum or fiberboard cylinders containing horizontally nested paper tubes. They are used exclusively with folding-fin aircraft rockets (e.g., 2.75-inch, ZUNI), the design of which permits multiple loading and launching. Aircraft rocket launcher packages provide a means by which rocket motors (and, in the case of the Aero 7D launcher, completely assembled rounds) may use the same containers from manufacture, through stowage, to final firing.

Frangible paper fairings are used in conjunction with launcher packages. These fairings are attached to both ends of the launcher during flight to provide low-drag aerodynamic characteristics. During firing, the fairings are disintegrated by rocket blast and by the forward movement of the rockets.

In most cases, launcher packages are jettisoned after firing and at the pilot's discretion. On training missions, however, configurations of launchers that have a service life of many salvos should not be jettisoned except in emergencies.

This chapter provides complete instructions for operation and maintenance of three rocket launcher package configurations: the Aero 6A, 10D, and 7D. The first two are used to ship and store rocket motors and to serve as launchers for complete rockets after assembly of the warhead to the motor. The last is used to ship, store, and launch completely assembled rounds.

Aero 6A Aircraft Rocket Launcher Package

General. The Aero 6A Aircraft Rocket Launcher Package is an expendable dual-purpose store which houses seven 2.75-inch Folding-fin Aircraft Rocket Motors from the time of manufacture until assembled with warheads and fired at the target. As used, these launcher packages are divided into two configurations: a shipping configuration and a flight, or rocket launcher, configuration.

Shipping Configuration. The shipping configuration, figure 7–1, consists of two packages: the launcher center section fitted with reusable shock absorbing end pans, seven rocket motors and rocket motor retaining plugs; and an expendable fiberboard shipping drum containing eight low-drag, frangible, paper fairings. One package of fairings is supplied with every four motor containers.

LAUNCHER CENTER SECTION. The launcher center section is made of seven paper tubes surrounded by a heavy fiberboard casing and capped with metal end bulkheads. The paper components are encapsulated with a tough plastic material which protects the paper against moisture and the effects of rocket blasts. The metal bulkheads are swaged in place and sealed to the casing. Three internal longitudinal tie rods, with fittings on the end bulkheads, provide attaching means for the shipping end pans.

A leaf spring detent latch retains the rocket in each launching tube until thrust loads of 10 to 15 g's are applied. However, simple manual unloading may be accomplished by rotating the rocket in the direction to tighten the warhead and pulling forward. The clockwise twisting causes a rocket fin hinge lug to engage a low-angle cam on the side of the detent. This cam drives the detent to the side and releases the rocket so it may be pulled forward and out of the launcher. Short wooden fillet sticks hold the detents in place and locally reinforce the paper tubes.

Flight Configuration. The launching configuration, figure 7–2, consists of one center section containing seven assembled rockets and equipped with two frangible fairings.

IGNITION. Electrical power for the rocket ignition system is supplied to the launcher by the aircraft 28-volt DC armament circuits through a jack-plugged ignition cable. The firing impulse is distributed to the seven rockets by a small molded plastic intervalometer, figure 7–3, attached to the after bulkhead of the launcher center

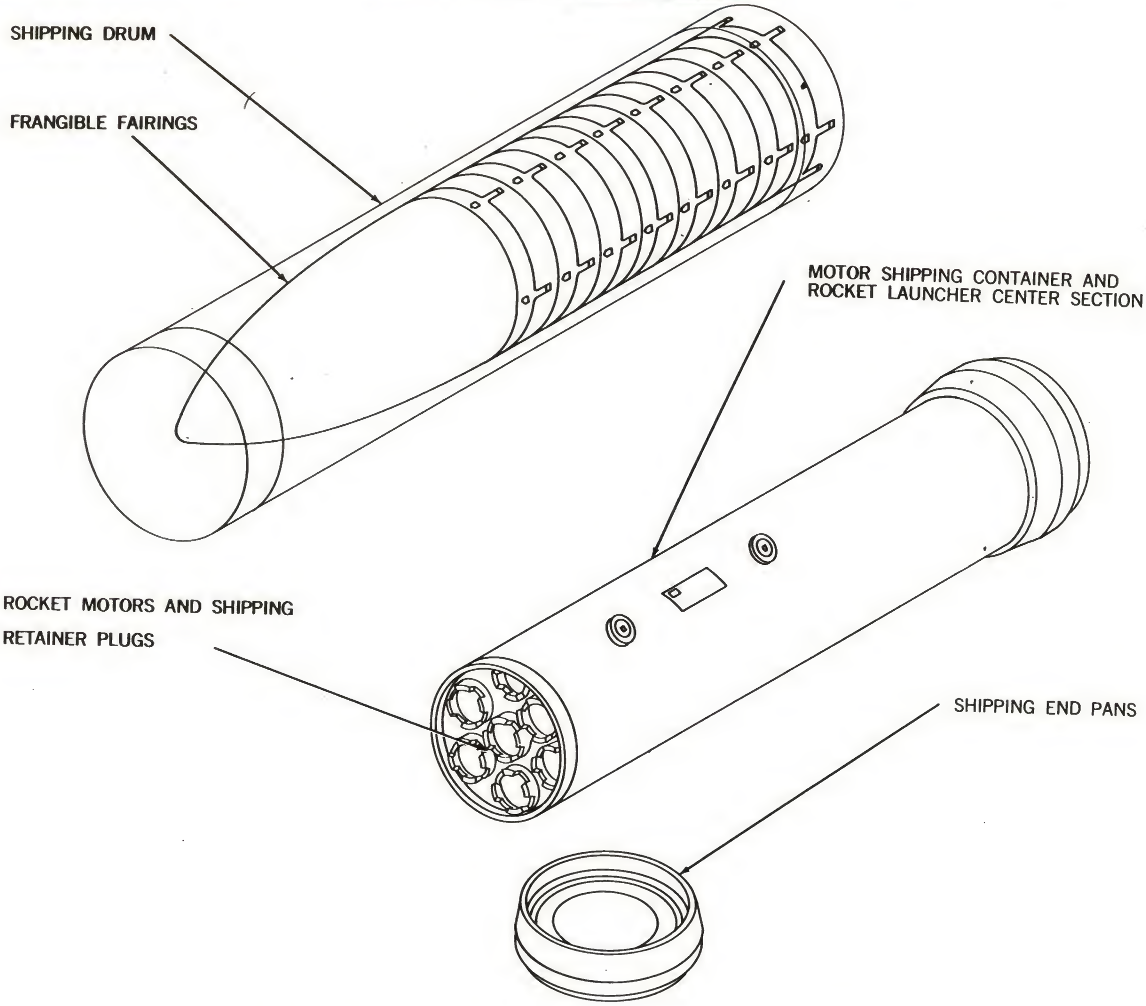


Figure 7–1. Aero 6A Aircraft Rocket Launcher Package.

section. The intervalometer, or ignition spider, has no moving parts and requires no maintenance. The wiring of the intervalometer converts the aircraft firing pulse into a ripple-salvo of firing pulses at the rate of 100 pulses per second. Blast from the last rocket to fire severs the ignition cable at the cable breaker and facilitates jettisoning of the spent launcher.

SUSPENSION PROVISIONS. The launcher suspends from the bomb hooks of Aero 14-type pylons by hangers. Hangers automatically extend from the launcher to provide pylon suspension means, figure 7-2. Tape covers the hanger wells and retracted hangers during shipment and storage.

FRANGIBLE FAIRINGS. The launcher fairings are made of treated pulp paper and will shatter readily from rocket impact or backblast. A metal band at the base of each fairing has six attach clips that slip over the launcher bulkhead to hold the fairing in place.

Aero 6A Aircraft Rocket Launcher Package Specifications.

Shipping configuration, motors:

Length	45 inches
Diameter	10½ inches
Weight	116 pounds
Capacity	7 meters

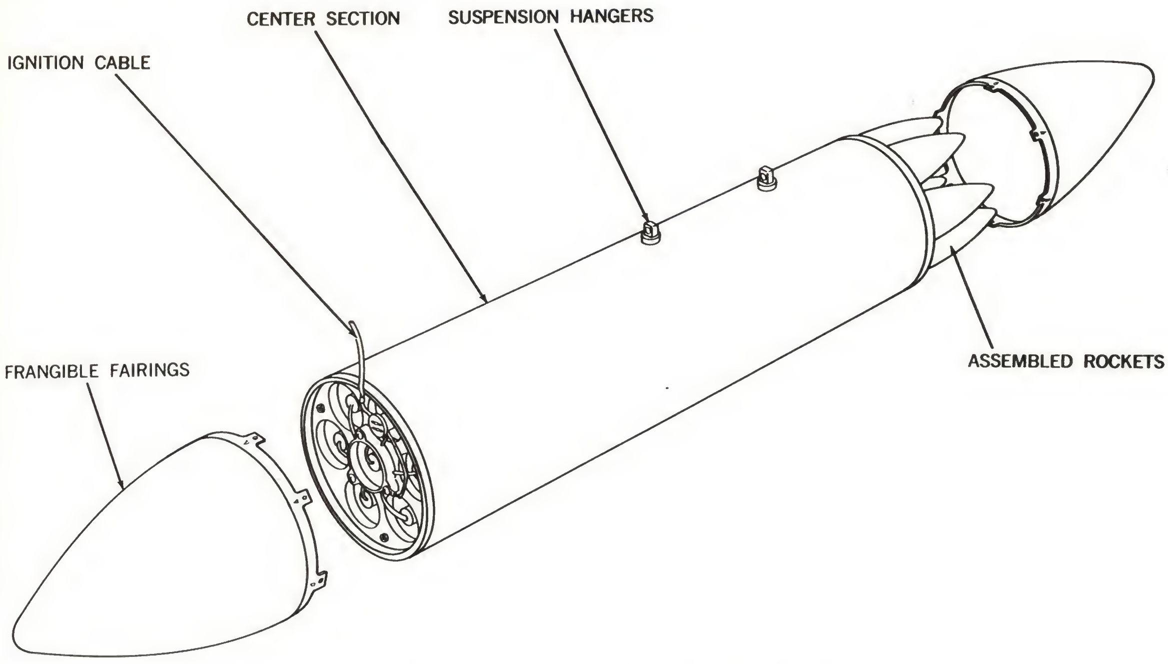


Figure 7–2. Rocket Launcher, Flight Configuration.

Shipping configuration, fairings:

Length	49 inches
Diameter	11½ inches
Weight	19 pounds
Capacity	8 fairings

Flight configuration:

Length with fairings	75.1 inches
Length without fairings	41 inches
Diameter	9¾ inches
Capacity	7 rockets
Weight loaded	148 pounds
Weight after firing	20½ pounds
Suspension	all Aero 14 racks
Firing rate	100 rounds/sec.

Preparation for Use.

UNPACKING. Aero 6A launcher packages may be delivered to the service on shipping pallets. In such cases, uncrate the units as follows:

1. Cut the steel banding strips around the crate.
2. Lift the upper wooden tray off the crate and remove vertical support timbers as necessary.
3. Remove launcher packages from the pallet.

MOTOR CONTAINERS, figure 7–4. When preparing Aero 6A launchers for use, re-

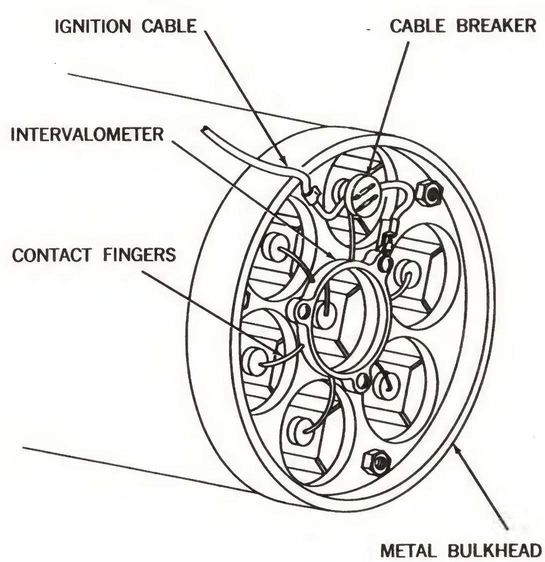


Figure 7–3. Ignition System.

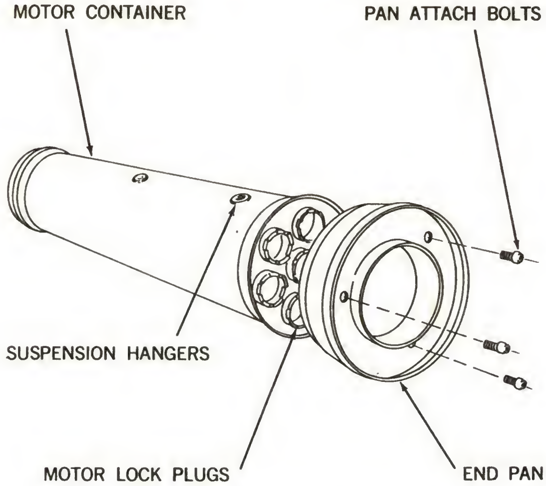


Figure 7–4. Removal of End Pans.

move shipping components from motor container, launcher center section, as follows:

1. Remove the three attach bolts from each shipping end pan with the wrench attached to the end pan.

> NOTE: If tie rod fittings unscrew instead of the attach bolts, remove entire rod assembly.

2. Remove end pan assemblies.
3. Unscrew motor lock plugs from head end of motors, figure 7–5. After one plug is removed, it may be inverted and used as a wrench to remove the remaining plugs.
4. Slice around edge of hanger nuts and remove the protective tape.
5. Using the screwdriver end of the end pan wrench, or similar tool, extend the suspension hangers by turning the slotted plug 90° in either direction. The hangers should spring out automatically, figure 7–6.
6. Return end pans and lock plugs to the nearest ordnance depot for reuse.

FAIRINGS, figure 7–7. Tear tape off both ends of fairing container and push fairings out of drum.

> CAUTION: The fairings are easily damaged if handled roughly. Do not drop, squeeze, or strike unprotected fairings.

UNLOADING THE LAUNCHER. Although it is intended that the rocket motors remain in the launcher until fired, it may be necessary to remove the motors manually.

1. Install a rocket head on the motor to be withdrawn, see following paragraphs.
2. Turn the motor in the direction to tighten the head and at the same time pull

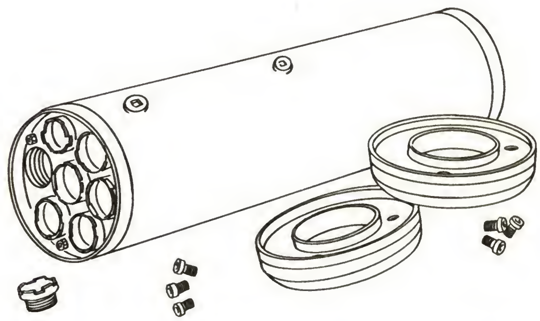


Figure 7–5. Motor Lock Plug Removal.

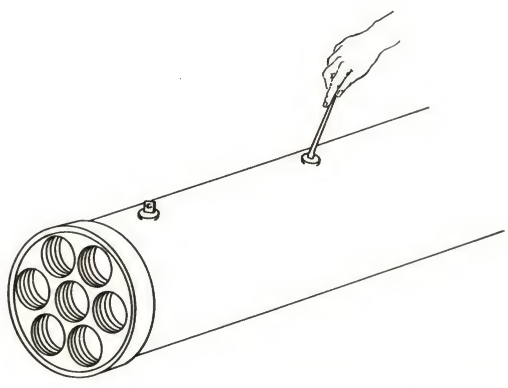


Figure 7–6. Extension of Suspension Hangers.

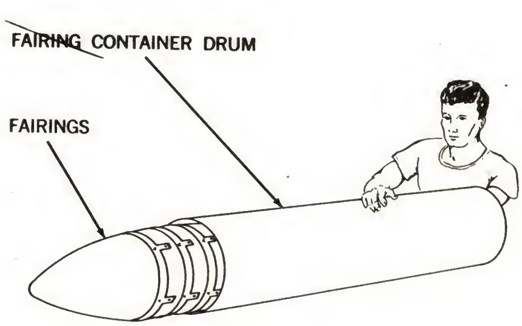


Figure 7–7. Fairing Unpacking.

forward. As the rocket fin hinge cams the detent open, the rocket can be withdrawn.

LOADING THE LAUNCHER. To load rockets into the launcher, proceed as follows:

1. Aline motor with the tube and position fins so they straddle the detent.

CAUTION: Motor fins must straddle the detent to prevent motor from sliding through and damaging the rocket ignition system.

2. Slide rocket into tube with a firm pressure until detent snaps into place.

3. Make sure detent is properly latched in groove of motor by pulling forward on the motor.

Preflight Assembly.

INSTALLING ROCKET HEADS, figure 7–8. Install warheads on the motors in the launcher as follows.

1. Draw the required number of warheads, seven heads per launcher, from the magazine.

WARNING

Handle high explosive warheads with extreme care, observing all prescribed safety regulations.

2. Position warheads in end of motor and screw securely into place. Install warhead on center motor first.

WARNING

Since turning the rocket in the direction to tighten the warhead may unlatch the detent, check each rocket to be certain the detent is properly latched after installing the warheads.

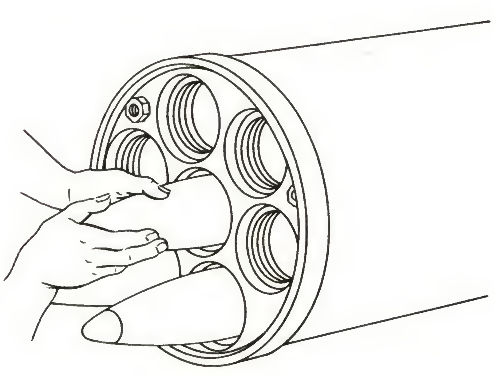


Figure 7–8. Rocket Head Installation.

CHECKING INTERVALOMETER. With rockets loaded in the launcher, check the intervalometer contact fingers for proper contact. If any finger does not contact the rocket ignition button, remove the rocket and carefully bend the contact finger into the tube. Reinstall the rocket, figure 7–3.

CAUTION: Bending the fingers carelessly or too far could damage the intervalometer.

TESTING AIRCRAFT ARMAMENT CIRCUIT. This test need not be conducted for each Aero 6A loading but should be done in conjunction with the airplane preflight check. The armament circuit must be in proper functioning condition to insure accurate, dependable, and safe launching of the rockets.

NOTE: The greatest single cause of firing failure is insufficient electrical power at the plug-in receptacles.

1. Increase engine rpm until cockpit voltmeter indicates full system voltage.

2. Plug an ammeter, 0–10 ampere range, directly into the HVAR wing receptacle.

3. Have the plane captain "Pickle" the station where the ammeter is plugged in and observe the reading. The ammeter should register between 4.5 and 7.5 amperes.

NOTE: A pulse less than 4.5 amps may not fire the entire rocket load. If the pulse exceeds 7.5 amps, the firing rate will be greater than 100 rounds per second.

4. Place armament switches in OFF position.

WARNING

Never plug in the launcher ignition cable without first making a "stray voltage" check at the HVAR receptacle.

Mounting Launcher. The launcher may be mounted empty or fully loaded and assembled.

1. Check out aircraft armanent circuit as described. Make sure switches are in OFF position.

2. Unlatch bomb hooks.

3. Loosen and extend sway braces as required.

4. Lift launcher into position and latch bomb hooks.

5. Tighten sway braces securely.

6. Safety the bomb rack with the clevis pin, washers, and cotter pin provided. Install pin through "RACK RELATCH" hole in pylon, placing one washer on each side of pylon.

WARNING

Unless Aero 14-type pylons are safetied in this manner, the firing impulse also will release the hooks and jettison the launcher.

Installing Fairings, figure 7–9.

NOTE: Aero 6A launchers should not be flown without fairings because of increased drag and the danger of air loads actuating the cable breaker before firing.

1. Snap forward fairing into place. Make sure all attach clips properly engage the launcher bulkhead.

2. Position after fairing as shown in figure 7–9.

3. Snap after fairing into place. Make sure all attach clips engage the launcher bulkhead.

CAUTION: Do not press on fairing nose or push sidewise on the paper portion.

Removing Fairings. If it becomes necessary to remove a fairing, pry each attach clip outward and slide fairing off the launcher.

Connecting Ignition Cable. Immediately prior to takeoff, connect rocket launcher ignition cable to aircraft as follows:

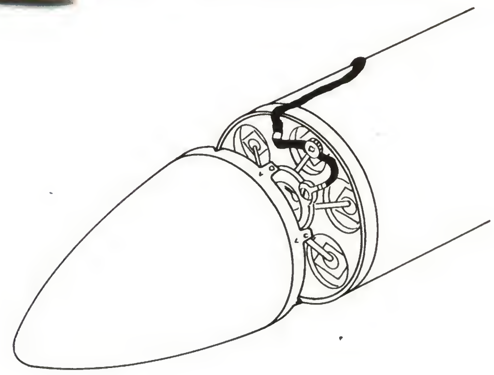


Figure 7–9. Installation of After Fairing.

1. Remove shorting clip from jack plug.

2. Insert jack plug in HVAR receptacle and turn plug 90° clockwise to lock.

WARNING

Stand to the side of the launcher when connecting ignition cable, in case inadvertent ignition should occur.

Dismounting Launcher. If it is necessary to remove the launcher from the airplane, with unjettisoned stores, proceed as follows:

1. Unplug the ignition cable.

2. Remove the cotter pin, washers, and clevis pin used to safety the bomb hooks.

WARNING

Provide suitable support to the launcher before pulling clevis pin, in case the hooks have been released and are resting against the pin.

3. Unlatch bomb hooks and lower launcher clear of nylon.

Operation. No new operation principles are involved in the Aero 6A rocket launcher. The ignited rockets overcome their detents by the thrust force of their propulsive gases and are guided by the launching tubes. The ignition intervalometer operates on a shunt resistance principle which delays the firing of subsequent rockets until the preceding rocket has launched and broken the circuit through it.

Operation of the Aero 6A aircraft rocket launcher is accomplished through the normal armament system of the aircraft. The launcher automatically ripple-fires the seven rockets at a rate of 100 rounds per second when supplied with an electrical pulse of 4.5 to 7.5 amperes at 28 volts DC.

Service Inspection, Maintenance, and Lubrication. Since the Aero 6A Rocket Launcher Package is an expendable store and is not intended for reuse, no service inspection, maintenance, or lubrication is required.

Aero 10D Aircraft Rocket Launcher Package

General. The Aero 10D Aircraft Rocket Launcher Package is a reusable dual-purpose store which houses four 5.0-Inch Folding-fin Aircraft Rocket, ZUNI, motors from the time of manufacture until assembled with warheads and fired at the target. It is suitable for air-to-ground or air-to-air rocket launching. Because of its dual purpose, the Aero 10D is shown as two separate configurations: the shipping configuration and the flight configuration.

Shipping Configuration. The shipping configuration, figure 7–10, consists of two packages: the launcher center section, containing four 5.0-inch Folding-fin Aircraft Rocket, ZUNI, motors, with the shock pans, covers, and locking rings installed; and the fairing container, containing six streamlined, frangible, fairings, enough to equip three launchers.

SHIPPING ENDS. The shipping ends, figure 7–10, comprise a multipurpose arrangement consisting of the shock pan as-

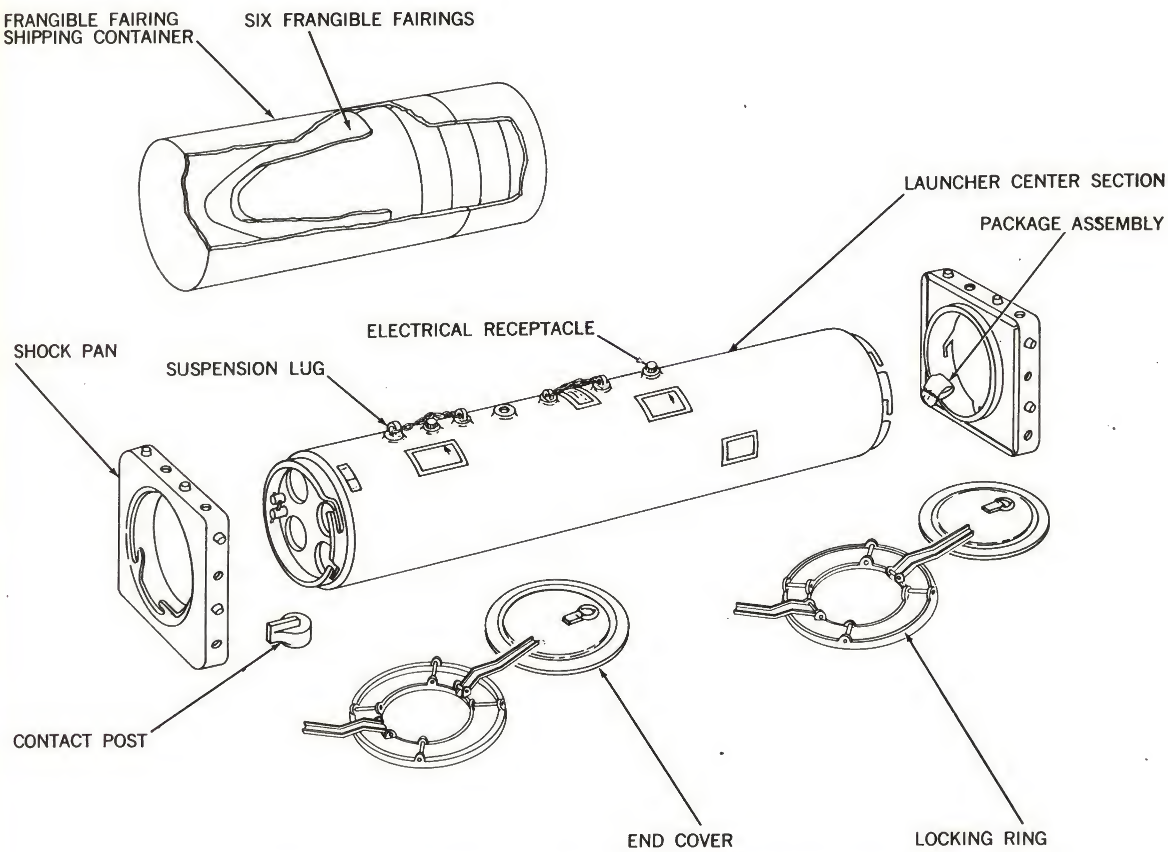


Figure 7–10. Shipping Container Package Configuration.

sembly, cover assembly, and locking ring assembly. The shock pan assembly is a heavy metal picture frame type structure which provides stability and rigidity. It is equipped with an alternate hold and pin arrangement on the sides, so arranged that when the launchers are stacked, the shock pans interlock. The cover is equipped with a rubber seal ring which, when compressed by the locking ring assembly, forms a watertight closure over the end of the launcher. The locking rings fit into grooves in the shock pan and serve to hold the cover in place and compress the seal ring. In addition, the locking ring is equipped with handles that can be hinged back perpendicular to the horizontal centerline of the launcher and latched to the shock pan by means of a spring-loaded pawl to facilitate manual handling.

LAUNCHER CENTER SECTION. The launcher center section contains the four launching tubes, the electrical ignition system (see flight configuration), suspension lugs, and a sear-type detent latch.

Flight Configuration. The flight configuration, figure 7–11, consists of a launcher center section, with the shock pan, cover, and lock ring assemblies removed, containing four assembled ZUNI rockets and a frangible fairing installed and securely locked in place on each end.

IGNITION. Electrical power for the rocket ignition system is supplied to the launcher by the 28-volt DC armament circuit of the aircraft. Electrical connection between the aircraft and the launcher is made through either of two paralleled AN 3107–14S–5P receptacle assemblies, figure 7–12, located in the vicinity of the launcher center section lugs. Pins "A" and "B" of the receptacles are positive connections to the aircraft. Pine "E" is the negative connection and is grounded to the launcher hanger beam which in turn is grounded to the aircraft through the suspension lugs. As a safety requirement, both receptacles are fitted with shorting plugs and dust caps, figure 7–12. A selector switch is located in the aft bulkhead of the launcher for preflight selection of either ripple- or single-firing of the rockets. A rotary relay-type intervalometer located in the forward bulkhead distributes the firing pulse to the individual rockets and is designed for a 50-millisecond time delay interval. Electrical connection to the rocket motor is completed in each tube through contact posts on the detent latch to a contact band on the rocket motor. See chapter 3. The forward contact post is the negative connection and the aft contact post is the positive connection.

In addition to the selector switch located in the launcher, some aircraft are equipped with a selector switch in the cockpit. In aircraft so equipped, the pilot has the inflight option of either ripple- or single-firing, provided the selector switch in the launcher is in the proper position before takeoff. In airplanes not so equipped, the method of firing is restricted to the pre-flight setting of the launcher selector switch. In aircraft equipped with the selector switch, there are two positive leads to the electrical receptacles in the launcher, one to pin "A" and

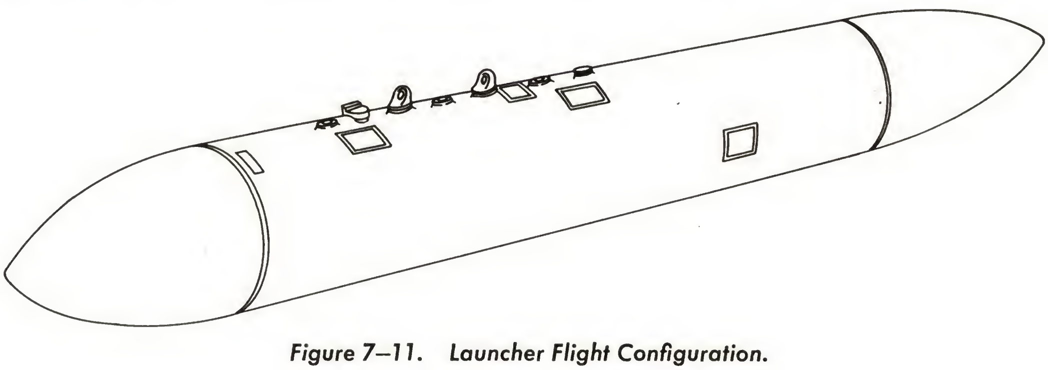


Figure 7–11. Launcher Flight Configuration.

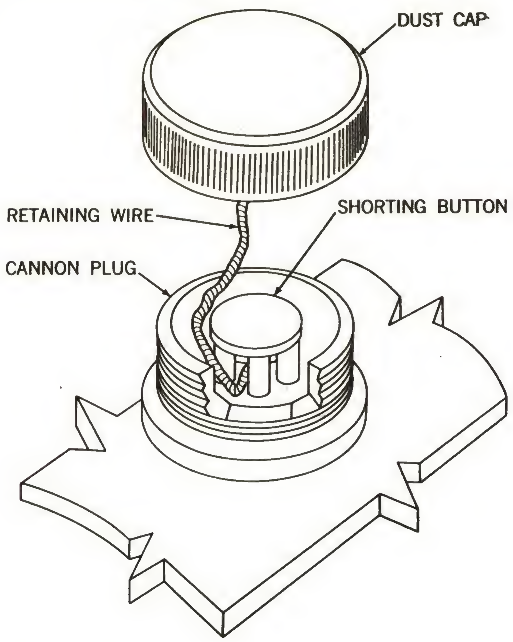


Figure 7–12. Shorting Button Installation.

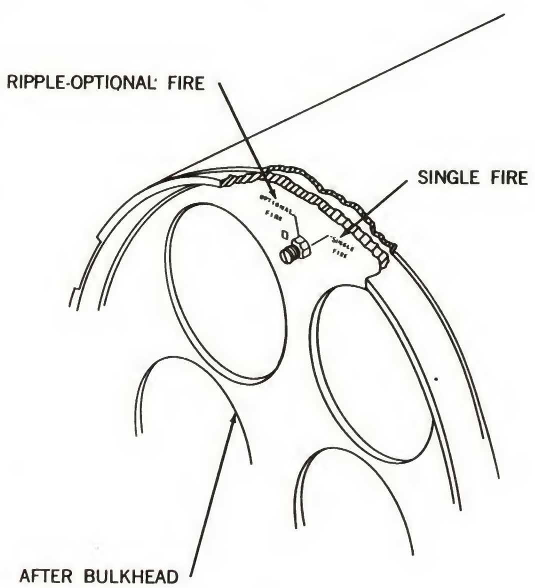


Figure 7–13. Fire Selector Switch.

one to pin "B". In aircraft not so equipped, there is only one positive lead, which is connected to pin "A".

LAUNCHER SELECTOR SWITCH. The launcher selector switch, figure 7–13, is located in the after bulkhead of the launcher. This switch has two settings, SINGLE and RIPPLE-OPTIONAL. When the launcher is used on an airplane that does not have a pilot's selector switch, the method of firing must be determined before takeoff and the launcher selector switch set accordingly. In this case, if the selector switch is set on RIPPLE-OPTIONAL, the pilot is restricted to firing the rockets in ripple-salvo at 50-millisecond intervals controlled by the intervalometer. If the launcher is being used on an airplane equipped with a pilot's selector switch, the launcher selector switch is to be set on RIPPLE-OPTIONAL. In this case, if the pilot selects RIPPLE-FIRE on his selector switch, the ignition pulse will go to the launcher through pin "A" of the receptacle, through the launcher selector switch to the ripple-fire connection on the intervalometer, and ripple-fire the rockets. If the pilot selects SINGLE-FIRE on his selector switch, the ignition pulse will go to the launcher through pin "B" of the receptacle, bypass the launcher selector switch, and go to the single fire connection on the intervalometer, single-firing the rockets at the pilot's discretion.

INTERVALOMETER. The intervalometer, figure 7–14, is a rotary relay-type located in the forward bulkhead of the launcher. It is designed so that when single-fire is used, the intervalometer acts as a stepper switch and fires one rocket on each ignition pulse from the airplane. If ripple-fire is used, the intervalometer converts the ignition pulse into a ripple rate with a 50-millisecond delay interval.

SUSPENSION PROVISIONS. Multiple suspension provisions, figure 7–15, make the Aero 10D launcher adaptable to most Navy and Air Force tandem suspension 14-inch and 30-inch bomb racks plus the United Kingdom single-suspension bomb racks. The Aero 10D launcher shall NEVER be suspended from a bomb rack that does not have independent ignition and jettisoning circuits.

FRANGIBLE FAIRINGS. The frangible fairings, figures 7–10 and 7–11, are made of

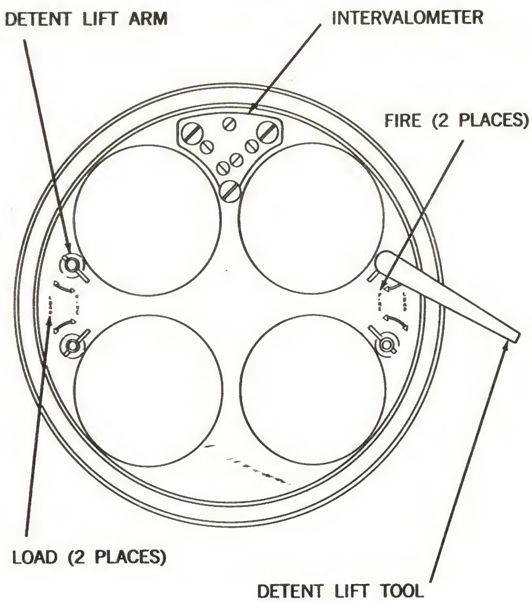


Figure 7–14. Launcher Forward Bulkhead.

treated paper and will shatter readily from rocket impact or rocket blast. The fairing has a lugged metal base and a leaf spring clip. The fairing base-band lugs engage grooves in the launcher center section end rings and, as the fairing is rotated clockwise, the fairing leaf spring clip drops into position to lock the fairing securely in place. The fairing fits flush with the outside surface of the center section to form an aerodynamically smooth joint.

Special Tools. The detent lift, 55A27C100, is used in conjunction with the Aero 10D Aircraft Rocket Launcher Package.

Aero 10D Aircraft Rocket Launcher Package Specifications.

Shipping configuration, motors:

Length, overall	98.51 inches
Cross section	16″ x 16″
Capacity (5.0-inch FFAR)	4
Weight, empty	140 pounds
Weight, loaded	366 pounds
Fairing container capacity	6

Flight configuration:

Length, overall	139.57 inches
Cross section	13.9 inches in diameter
Capacity (5.0-inch FFAR)	4
Weight, empty	99 pounds
Weight, loaded	527 pounds
Suspension	Multiple
Ignition	28-volt DC
Firing Rate:	
Ripple	50 millisecond interval

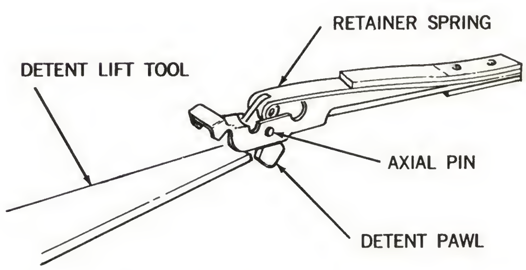


Figure 7–16. Detent Relatching.

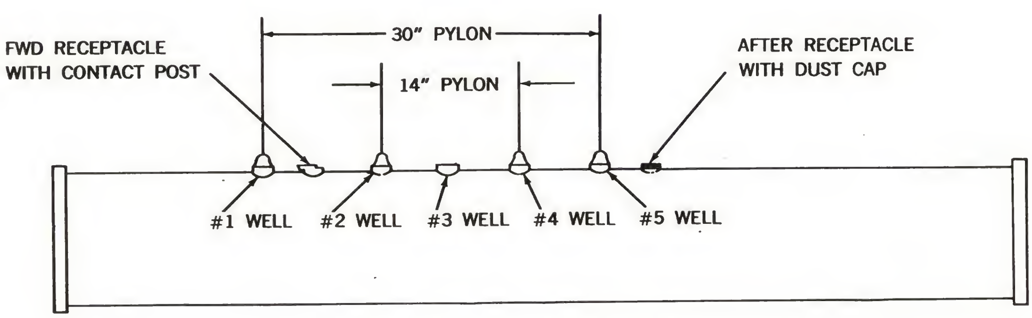


Figure 7–15. Hanger and Receptacle Arrangement.

Single	Optional
Operating temperature range	—65° F to 165° F

Preparation for Use and Reshipment.

PREPARATION OF AERO 10D SHIPPING PACKAGE FOR ROCKET LOADING. To load the launcher for shipping and stowing complete with four 5.0-inch FFAR ZUNI motors, it is necessary to remove only the forward locking ring and cover. Proceed as follows:

1. Break lockwire holding locking ring to forward shipping end.
2. Swing handles out. Latches should not be engaged when removing ring.
3. Rotate locking ring, with handles, in a counterclockwise direction until pins are disengaged from slots in shipping end, and remove.
4. Lift out end cover, tubular dunnage, and package assembly.
5. Remove detent lift tool from package assembly.

LOADING ROCKETS IN LAUNCHER.

CAUTION: Package must be in horizontal position to load.

1. Rotate all lift arms to load position with detent tool, figure 7–14.
2. Insert aft end of motor, slowly, into muzzle end of launcher tube until nozzle assembly hits aft stop.
3. Rotate lift arm to fire position, figure 7–14. Slide motor forward until detent drops into detent groove. An audible "click" indicates positive engagement with the motor detent groove.
4. Repeat loading procedure until all four motors have been loaded.
5. Place detent tool in package assembly.
6. Replace package assembly and tubular dunnage.

ROCKET CONTINUITY CHECK.

WARNING

Perform rocket continuity check per depot procedure. This check to be performed by Naval Ammunition Depot ONLY.

PREPARING SHIPPING PACKAGE FOR SHIPMENT.

1. Check to make sure rubber seal ring on cover is properly installed in groove and free of foreign material.
2. Install end cover.
3. Install locking ring assembly by engaging pins in slots on shipping end, and rotate clockwise until pins bottom at end of slots.
4. Fold handles downward and snap into spring catches.
5. Use lockwire to secure locking-ring assembly in place using one pin and hole provided in shock pan.

Installing Launcher on Aircraft.

TESTING AIRCRAFT ARMAMENT CIRCUIT. Proceed in accordance with current instructions to check firing circuit for voltage.

1. Increase engine RPM until cockpit voltmeter indicates full system voltage —28 volts.
2. Connect an ammeter (0–10 ampere range) directly to the HVAR wing electrical receptacle.

NOTE: The greatest single cause of firing failure is insufficient power at the HVAR electrical outlet.

3. Energize the station where the ammeter is connected and note the reading. The ammeter should register a minimum of three amperes. A pulse less than 3.0 amperes may not fire all four rockets.
4. Place armament switches in OFF position.

SHIPPING PACKAGE TO AIRCRAFT PREPARATION, figure 7–15.

1. Remove forward locking rings and cover by proceeding in accordance with instructions provided.
2. Remove detent lift tool and post assembly from package assembly.
3. Discard all dunnage and reinstall cover and locking ring.
4. Remove dust cap and shorting button from forward receptacle and install post assembly for Aero 15B and all other pylon-

type suspensions using forward contact post.

5. Unscrew dust cap from aft receptacle, figure 7–12, and allow to hang by wire secured to shorting button.

6. For pylons using rear contact receptacle, such as Aero 20A, remove shorting button from aft receptacle and have forward shorting dust cap hang by wire.

7. Swing locking ring handles outward until latches engage with shock pan plate.

WARNING

Make certain shorting button is securely pressed into receptacle.

8. On Aero 15B pylons leave suspension lugs in No. 2 and No. 4 position, remove hanger lugs from positions No. 1 and No. 5.

9. For 30-inch heavy duty pylon suspension, remove suspension lugs from No. 2 and No. 4 well positions.

10. For single-lug suspension pylons, remove suspension lugs from No. 1, No. 2, No. 4, and No. 5 positions and install United Kingdom suspension lug, not provided, in the center or No. 3 position.

NOTE: Adjust suspension lugs to vertical dimension as shown on decal opposite lugs. Dimension to be from inside top of lug to face of well. If lugs are not 90° to launcher, back off enough to aline.

SHIPPING PACKAGE TO PYLON ATTACHMENT.

1. Prepare ejector rack on aircraft for accepting suspension lugs per instructions contained in aircraft operating instructions.

2. Aline suspension lugs with pylon bomb hooks. On pylons utilizing striker arms, Aero 15B, simultaneously aline contact post with slot in forward rocket rail of pylon.

3. For pylons not utilizing striker arm, remove ignition cable from pylon and connect it to the nearest receptacle on launcher. On Aero 20A and all other heavy-duty bomb racks, disconnect the HVAR receptacle inside the aft access panel prior to attaching cable to launcher.

4. Grasping four handles, elevate package into position on ejector rack and lock suspension hooks.

5. Position sway bracing on ejector rack to rigidly support package per aircraft operating instructions.

CONVERTING SHIPPING PACKAGE TO FLIGHT CONFIGURATION.

1. Remove fore and aft locking rings in accordance with instructions provided.

2. Remove front and rear covers.

3. Lift spring latch on shock pans, rotate shock pans counterclockwise as far as possible, and pull away from center section.

4. Screw rocket heads into rocket motors and tighten securely with a strap wrench to 80 ft/lbs.

5. Set the selector switch on RIPPLE OPTIONAL or SINGLE position. See figure 7–13 and instructions provided.

6. Remove frangible fairings from fairing container.

7. Aline arrow on fairing with arrow on launcher marked UNLOCK.

8. Push fairing on center section assembly until seated against end ring.

9. Rotate fairing clockwise until spring latch "clicks" into locked position. Red arrow on fairing should aline with red arrow on launcher marked LOCK.

LAUNCHER ARMAMENT PROCEDURE.

1. Perform standard arming stray voltage check in accordance with existing instructions. Arm the launcher by dropping the striker arms on the Aero 15B bomb rack or attaching the HVAR cable inside the Aero 20A ejector rack. Remove shorting button, figure 7–12, from electrical receptacle by pulling on dust cap. If practical, hold the shorting button up for pilot observation.

2. Return shorting button and dust cap to stock for future use.

WARNING

A discarded dust cap assembly on runway or deck can be picked up

by jet intake and cause serious damage to a jet engine.

LAUNCHER UNLOADING PROCEDURE.

1. Replace shorting button immediately after return from flight.
2. Remove fairings.
3. Remove rocket heads and return to magazine for stowage.
4. Replace shock pans, covers, and locking ring assemblies.
5. Disconnect launcher from airplane and return to magazine stowage.

DETENT RELATCHING PROCEDURE. To relatch the detent after a rocket has been fired, proceed in the following manner.

1. Rotate the detent lift arm to the lock position.
2. Insert handle portion of detent lift into the launcher tube and engage the forward edge of the detent pawl within the detent clearance hole in the launcher tube, figure 7–16.
3. Push the detent pawl down and aft. The detent pawl will rotate about its axial pin and snap back into a "cocked" position.
4. Rotate the detent lift arm to the "load" position. The launcher now is ready to be reloaded.

DISPOSITION OF MISCELLANEOUS HARDWARE. Except when service conditions prohibit, shock pans, covers, locking rings, unused suspension lugs, and dust cap-shorting plug assemblies removed from the launchers should be retained for reassembly to the launcher for protection, reshipment, or storage.

Operating Instructions.

PRINCIPLES OF OPERATION. Operating principles utilized in the Aero 10D Rocket Launcher-Shipper Package are proven production methods. The ignited rockets override the sear-type detent latches and release the rockets. The rockets may be single- or ripple-fired. The firing pulse is distributed to the individual rockets by a rotary relay intervalometer which is mounted in the launcher forward bulkhead. The frangible fairings shatter readily from rocket impact and backblast.

OPERATION. Firing pulse for the Aero 10D is through the standard armament system in the aircraft. The 28-volt DC power passes through the intervalometer where the pulse is dispersed to each rocket. If ripple-fire is employed, the intervalometer automatically fires the rockets at 50-millisecond intervals. If single-fire is employed, the intervalometer relay rotates only one position each time a pulse is received. A separate impulse is required to jettison the launcher in case of emergency.

Maintenance Instructions. The Aero 10D package is both a combat weapon and a reusable training device. Therefore, reasonable care and maintenance should be exercised during its usefulness. Continued satisfactory operation can be assured by cleaning the firing contact points after every firing and before loading after extended nonuse. Fine emery cloth should be brushed over the points to assure a good point contact. Care should be taken not to mark or scar the end rings to insure repeated attachment of fairings. A fine file should be used to remove any scars or marks that do occur.

The Aero 10D should have a minimum useful life of approximately 100 rockets, or 25 salvos.

During wartime conditions or aircraft emergencies, the launcher may be jettisoned at the option of the Commanding Officer of the ship.

Launchers which develop operational difficulties that cannot be corrected by simple repair or part replacement shall be discarded.

Test Procedure

WARNING

Tests outlined shall never be conducted except on an empty or unloaded launcher.

To check the intervalometer the following procedures should be followed, using a 24–30-volt DC source.

1. Attach positive lead to pin "A" on electrical receptacle.

2. Attach negative lead to pin "E" (ground).

3. Set the selector switch on SINGLE; apply voltage across pin "A" and "E"; intervalometer should step once and stop.

4. Repeat step 3 with selector switch on RIPPLE-OPTIONAL; intervalometer should run continuously.

To check the launcher tube detent for firing pulse, proceed in the following manner:

1. Attach positive lead of a voltmeter to rear contact pin on detent arm.

2. Attach ground lead of the voltmeter to any convenient portion of launcher, such as bulkhead or lug well receptacle.

3. Set voltmeter on lowest voltage DC scale, 0 to 2.5 DC scale. The voltmeter will not indicate current passage if a higher voltage scale is used since the ignition pulse only lasts for 50 milliseconds.

4. Set selector switch to SINGLE.

5. Apply voltage across pins "A" and "E".

6. Voltmeter indicator arm will move quickly to indicate passage of current and return to zero reading immediately.

7. Set selector switch on RIPPLE-OPTIONAL.

8. Repeat step 5.

9. Voltmeter indicator arm will move up scale to indicate passage of current and remain there until the voltage is removed.

NOTE: The intervalometer is self-shorting at all times and all meter reading will be zero resistance until voltage is applied. The self-shorting function of the intervalometer in effect supplements the requirement for the shorting cap on the two electrical receptacles. However, nonuse of an external shorting device is contrary to existing ordnance regulations.

Aero 7D Aircraft Rocket Launcher Package

General. The Aero 7D is an expendable launcher-shipper package unit for shipping, stowing, and firing nineteen completely assembled 2.75-Inch Folding-Fin Aircraft Rockets. It is suitable for air-to-ground or air-to-air rocket launching. Unlike the Aero 6A and 10D launchers, the Aero 7D is not divided into two separate configurations, one for shipping and one for firing. Because 2.75-inch folding-fin aircraft rockets are shipped, stored, and fired using the same Aero 7D container-launcher, the components will be described for a single launcher configuration.

The Aero 7D Rocket Launcher Package consists of a center section, reusable shock pans, and frangible fairings. The center section contains nineteen assembled 2.75-inch Folding-fin Aircraft Rockets, the launching tubes, suspension provisions, the launcher ignition system, end covers, rubber retainers, and locking rings. The frangible fairings are shipped and stowed in a separate container, figure 7-17. Each fairing container accommodates six frangible fairings. Both the center section and fairing container are watertight.

Launcher Center Section. The launcher center section is constructed of nineteen thermosetting plastic impregnated paper tubes clustered and bonded together to form an integral part of the structure. This cluster is contained in an aluminum skin. The ends are closed and supported with metal bulkheads. External suspension lugs are screwed into thread inserts to provide for attachment to aircraft bomb racks. In each tube, the rocket is held in place by a flexible metal spring detent; the rocket blast upon firing releases this spring.

Shipping Retainers. A hard rubber pad is fitted to the front of the package to provide support for the rocket nose should any rocket become dislodged from its detent during shipment and stowage. A soft rubber pad is fitted to the rear of the package to support the rocket fin retainers of the

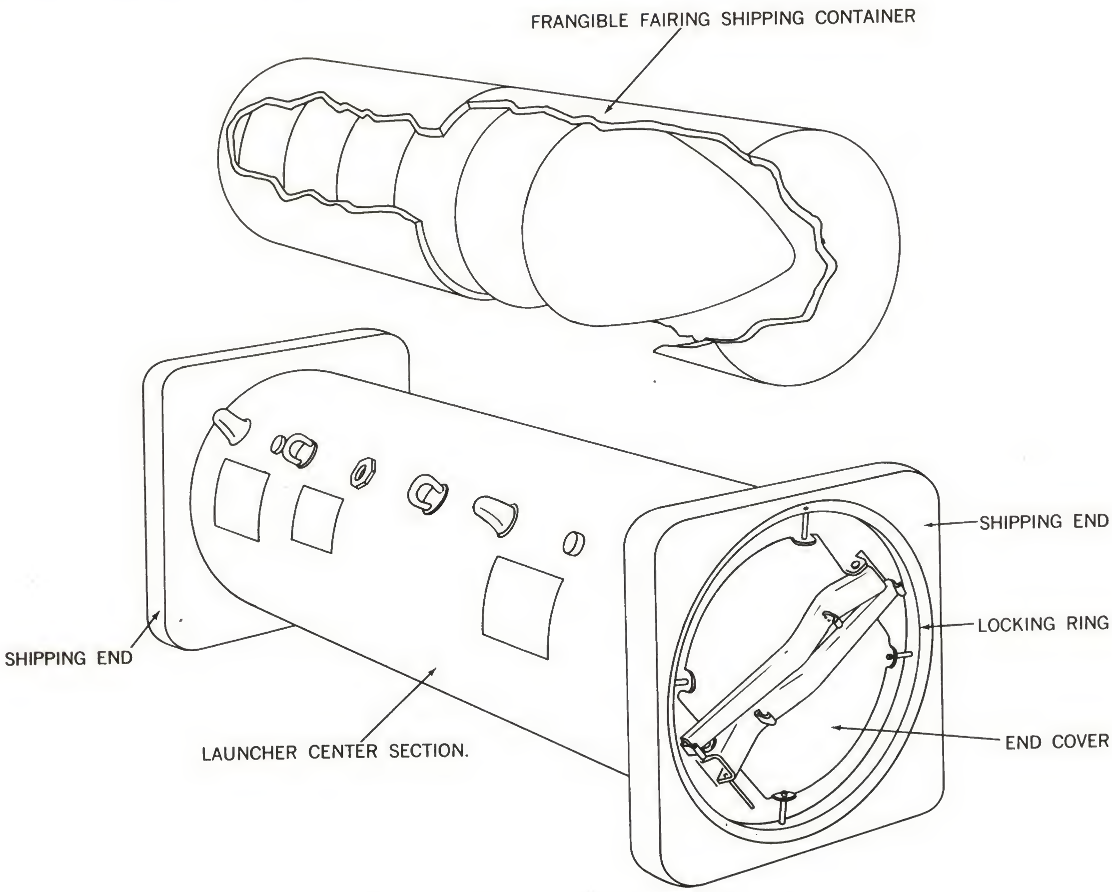


Figure 7–17. Aero 7D Aircraft Rocket Launcher Package.

rockets during shipment and stowage. These items are removed when the fairings are installed.

Shock Pans. Shock pans are square metal parts used to support the ends of the launcher center section when it is packaged for shipment or storage, figure 7–17. These parts provide stability to the package for single or multiple stacking, and contain locking slots for compressing the cover seal ring by means of a locking ring assembly for sealing the center section and assuring a watertight container. The end pans are removed when the fairings are installed.

Ignition. Electrical power for the rocket ignition system is supplied to the launcher by the 28-volt DC armament circuit of the aircraft. Two receptacles are provided for making contact. One receptacle is located near the forward end of the center section, the other near the after end of the center section. Either receptacle may be used for making contact. The type of bomb rack used with the launcher determines which receptacle is used. On aircraft using bomb racks with striker arms, Aero 14 or 15 type combination bomb rack and rocket launcher pylon, a post assembly is inserted in the receptacle. Grounding of the circuit is provided through the suspension lugs which attach the launcher to the aircraft. As a safety precaution, shorting buttons are placed in each receptacle, figure 7–18. The shorting buttons are not removed from the receptacles until connections are made and just before the aircraft is ready for flight. When fired, current passes through an in-

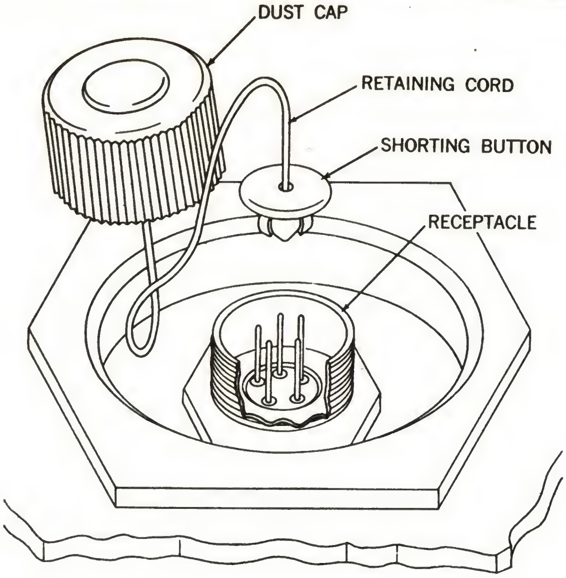


Figure 7–18. Shorting Button Installation.

tervalometer which ripple-fires the rockets in pairs at 10-millisecond intervals.

Each contact receptacle is protected by a dust cap and shorting button assembly, figure 7–18. The shorting button is a leaf spring button which is pressed in place between the five pins of the receptacle. A retaining cord connects the button with the inside of the dust cap. The dust cap is screwed in place over the receptacle and prevents entrance of foreign material. Before making electrical contact to the aircraft, the dust caps are removed from both receptacles and allowed to dangle. The shorting button is removed from the position to be used when electrical connection is made. The remaining shorting button is pulled out just prior to takeoff.

The firing impulse is distributed to the individual rockets by a shunt-fuse intervalometer which is installed through the aft bulkhead into the wiring harness receptacle. The intervalometer has no moving parts and requires no maintenance. The wiring of the intervalometer converts the firing pulse into a ripple-firing with a 10-millisecond delay interval.

Frangible Fairings. Frangible fairings, figure 7–19, are attached to the forward and aft ends of the center section after the center section has been attached to the aircraft. The launcher fairings are made of treated paper and shatter readily from rocket impact or blast. A metal band at the base of each fairing provides lugs which engage grooves in the center section end rings. As the fairing is rotated clockwise, a leaf spring clip locks the fairing in place. When attached, the fairing is flush with the outside surface of the center section and forms an aerodynamically smooth joint.

Suspension Provisions. Multiple suspension provisions, figure 7–19, make the Aero 7D adaptable to most Navy and Air Force tandem 14-inch and 30-inch bomb racks, and single bomb hook United Kingdom bomb

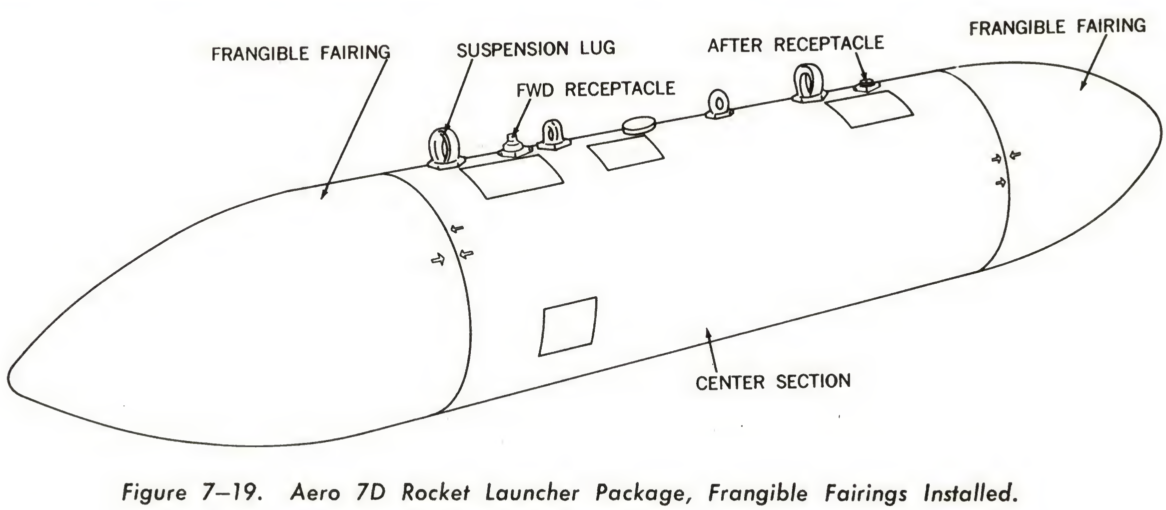


Figure 7–19. Aero 7D Rocket Launcher Package, Frangible Fairings Installed.

racks. Threaded suspension lugs not being used on a particular bomb rack are removable to provide minimum weight and maximum clearance for each installation.

Special Tools. No special tools are used in conjunction with the Aero 7D aircraft rocket launcher package.

Aero 7D Aircraft Rocket Launcher Specifications

	PACKAGED	FAIRINGS INSTALLED
Overall length	53.3 inches	98.6 inches
Cross section	18 inches x 18 inches	15.7 inches in diameter
Capacity (2.75-inch FFAR)	19	19
Weight, empty (lb)	129.8	74.3
Weight, loaded (lb)	487.7	430.9
Suspension	multiple	
Firing rate (interval)	10 milliseconds	
Fairing container (loaded)	44 pounds	
Operating temperature range	—65° F to 165° F	

Preparation for Use and Reshipment.

PREPARATION FOR USE. The Aero 7D Rocket Launcher Packages are shipped completely assembled with fore and aft shock pan, cover, and locking ring assemblies attached. The empty launcher is shipped to the ammunition loading depot where it is partially disassembled and loaded with nineteen 2.75-Inch Folding-fin Aircraft Rockets complete with warheads attached. The loaded launchers then are stowed or placed into service.

SHIPPER LOADING. To load the launcher for shipping and stowing, it is necessary to remove only the forward locking ring, cover, and rubber retainer, figure 7–20. Disassemble the launcher as follows:

1. Break safety wire holding locking ring on forward end; forward end indicated by arrow on nameplate.
2. Lift handles from spring catches on locking ring assembly and swing outward to convenient leverage position. Do not engage handle clips with shock pan.
3. Rotate handles counterclockwise until pins on locking ring disengage slots in shock pan, and remove.
4. Lift out cover and shipping retainer.

LOADING ROCKETS IN LAUNCHER.

CAUTION: Package must be in a horizontal position for loading. Rocket warheads must be attached to rocket motors before installing in launcher.

1. Aline fins of rocket so that arrow mark on the forward bulkhead is between two fins. Arrow mark indicates the detent position in the tube, figure 7–21.
2. Insert fin end of rocket slowly into tube until rocket detent groove snaps into position over launcher detent latch.

CAUTION: To prevent damage, do not ram rocket against detent. Slide gently into place.

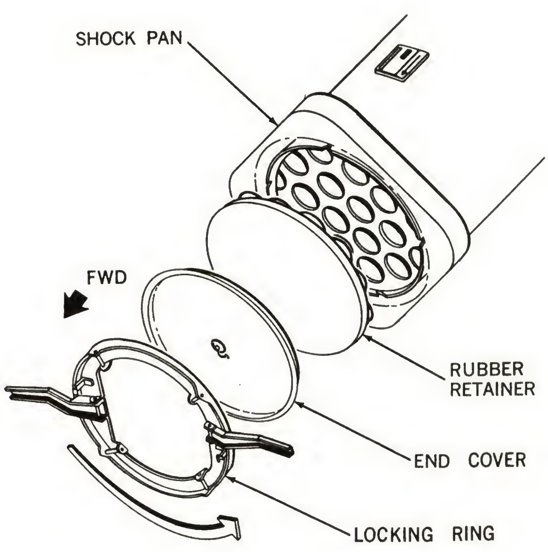


Figure 7–20. Disassembly for Rocket Loading.

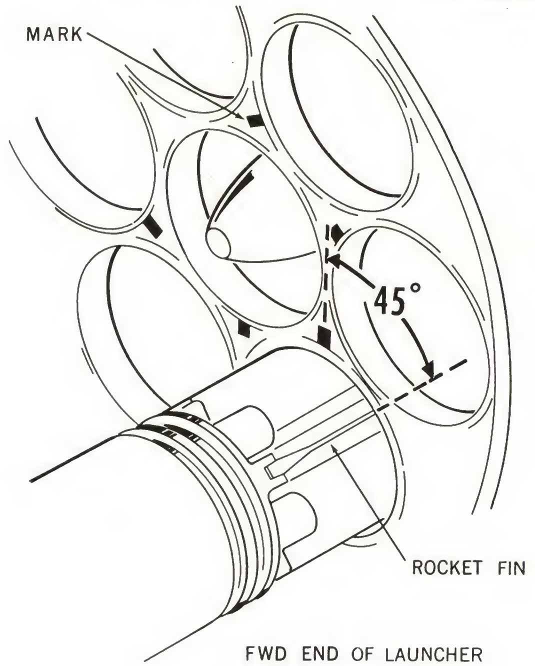


Figure 7–21. Loading Rocket into Launcher.

3. Repeat loading procedure until nineteen rockets have been loaded into package.

ROCKET CONTINUITY CHECK. Perform rocket ignition circuit check in accordance with ammunition depot procedures.

WARNING

This check to be performed by Naval Ammunition Depot ONLY.

1. If continuity is not obtained, check rockets to make certain detents are latched.

NOTE: Rocket is not latched if warhead protrudes from launcher, or if rocket may be easily pulled out of tube.

2. If any one detent is not latched, remove rocket from the tube.
3. Check for visual flaws and reinsert rocket as directed.
4. Repeat continuity test.
5. If continuity is not obtained, reject launcher and report by RUDUM to the Bureau of Aeronautics.

ASSEMBLY OF LOADED LAUNCHER.

1. Replace shipping retainer, pressing down until the retainer is even all the the way around.
2. Check to make sure rubber seal ring on cover is properly installed in groove and free of foreign material.
3. Install cover.
4. Install locking ring assembly by engaging pins in slots on shock pan and rotate clockwise until pins bottom at ends of slots.
5. Fold handles downward and snap into spring catches.
6. Safetywire locking ring assembly in place using one pin and hole provided in shock pan.

TESTING AIRCRAFT ARMAMENT CIRCUIT. Proceed in accordance with current instructions to check firing circuit for voltage.

1. Increase engine speed until cockpit voltmeter indicates full system voltage, 28 volts.
2. Connect an ammeter, 0–10 ampere range, directly to the HVAR wing electrical receptacle.

NOTE: The greatest single cause of firing failure is insufficient power at the HVAR electrical outlet.

3. Energize the station where the ammeter is connected, and note the reading. The ammeter should register between 4.5 and 7.5 amperes. A pulse less than 4.5 amperes may not fire the entire rocket load. If the pulse exceeds 7.5 amperes, the firing delay time will be reduced, resulting in a more rapid firing rate.
4. Place armament switches in OFF position.

ATTACHING SHIPPING PACKAGE TO AIRCRAFT. Figures 7–22, 7–23, and 7–24.

1. Remove post assembly from waterproof bag wired to aft locking ring.
2. Remove front receptacle dust cap and ground button assembly, and install post assembly. The correct position of the post assembly on the receptacle should be determined by examining the post assembly. The post assembly will either be marked FWD or will have a raised projection. In either case, the post assembly should be installed

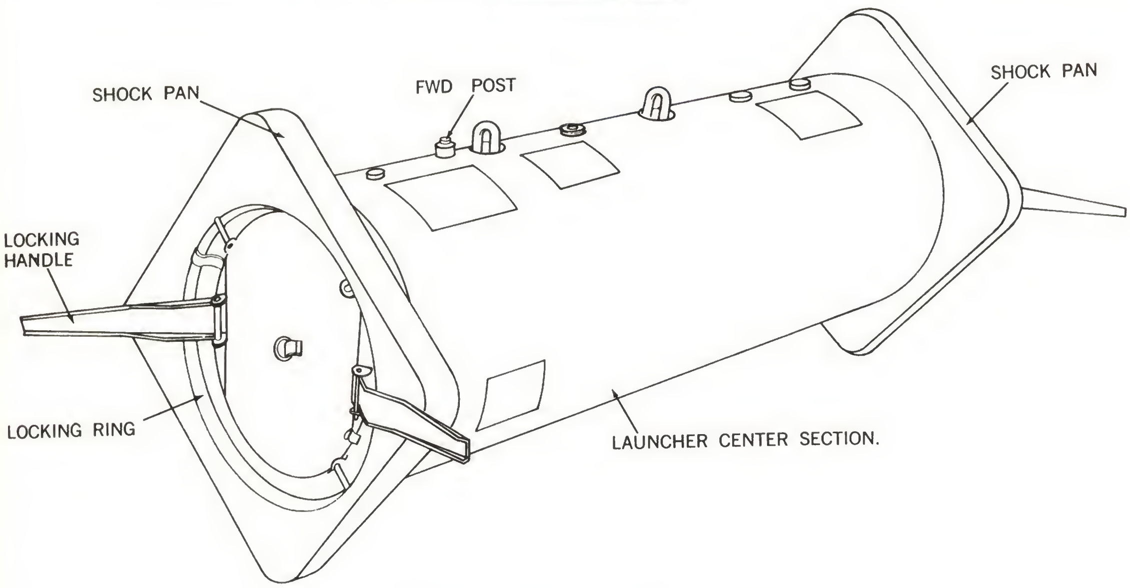


Figure 7–22. Launcher, Prepared for Lifting.

with the mark or projection facing forward on the launchers.

3. For Aero 14, or 15 type bomb racks using forward contact post, unscrew rear receptacle dust cap and allow it to hang by the line secured to the shorting button.

4. For bomb racks using rear contact receptacle, such as Aero 20A, step 2 applies to rear receptacle, and step 3 applies to front receptacle.

5. Remove extra suspension lugs that are not used for bomb rack on aircraft, and remove dust cap from center threaded insert.

6. Prepare bomb rack on aircraft for accepting suspension lugs per instructions contained in aircraft operating instructions.

7. Rotate launcher on ground to position as shown in figure 7–22, and lift handles from spring catches (both ends) and swing outward.

8. Lock handles into carrying position by engaging spring clips on handles in holes in shock pans.

WARNING

Make sure the spring clips are firmly engaged with the shock pans before manually handling the launcher. Failure to do so may result in serious injury to personnel.

9. Grasping four handles, elevate package into position on bomb rack and lock suspension lug hooks.

10. Position sway braces on bomb rack to rigidly support package per aircraft operating instructions.

11. Remove fore and aft locking ring assemblies, cover assemblies, and forward shipping retainer as follows. Remove safety wire from locking ring, rotate locking ring counterclockwise until pins disengage slots in the shock pan, and remove locking rings. Remove covers and forward shipping retainer.

12. At this point, inspect ends of tubes for fractures or severe cracks. If any internal damage to tubes is found, remove the rockets as specified following and use with reduced load. If more than three rockets have to be removed, dispose of launcher as outlined.

13. Lift spring latch on shock pan just far enough to disengage latch. Lifting too far will bend the spring and cause it to take a permanent set. Rotate the shock pan counterclockwise as far as possi-

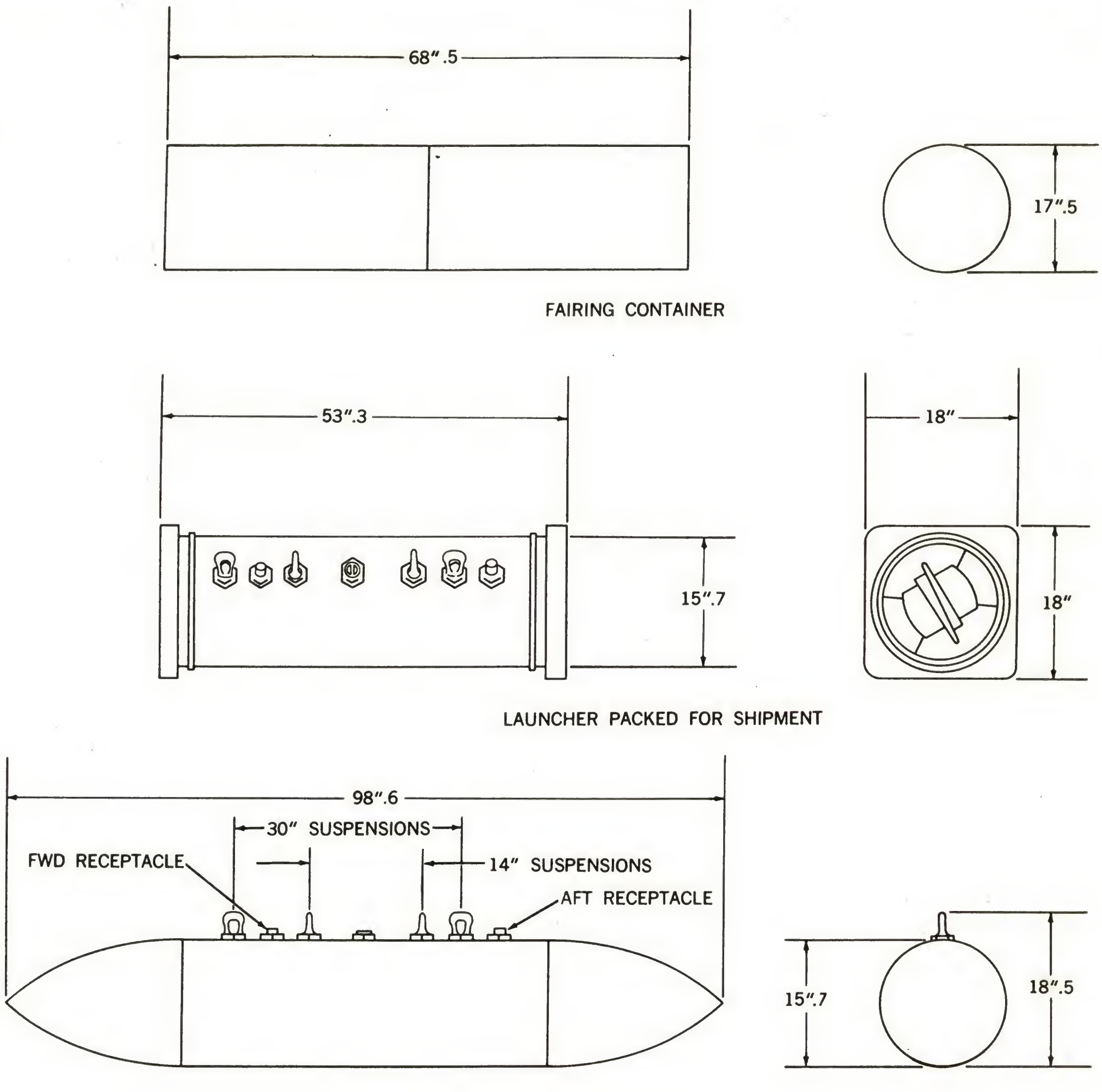


Figure 7—23. Dimensional Outlines.

ble and pull away from center section.

14. Check intervalometer for secure installation at aft end of center section.

WARNING

To prevent obstructed motor activation at firing, inspect the relative alinement of the rocket noses visually. Rocket noses suspected of being out of relative position shall be rotated clockwise until the motor positions itself against the detent assembly. Evidence of a film of black substance on the nose of the rocket indicates that a warhead became loose enough during shipment to chafe against the forward shipping retainer. Remove the rocket in accordance with instructions provided following. Reseat the warhead against the motor tube by giving the warhead a sharp clockwise rotation over the

last one-quarter turn, and then reload the rocket into the launcher in accordance with instructions provided.

15. Check two and three finger contact points for the positive contact on rocket fin retainer contact button.

INSTALLING FAIRINGS. Remove two frangible fairings from container and install one on each end of the center section assembly as follows:

1. Aline arrow on fairing with UNLOCK arrow on launcher.

2. Slip fairing on center section assembly until end of launcher is fully engaged.

3. Rotate fairing clockwise until spring catch snaps into locked position. Red arrow on fairing then is alined with red arrow on launcher marked LOCK.

NOTE: The fairing locking procedure can be accomplished more easily by use of a belt of composition rubber or other suitable material placed around the fairing band and held tight by hand during the rotating procedure.

WARNING

Failure to lock the fairing into its proper position will cause loss of the fairing band at firing, which may endanger the aircraft and pilot.

LAUNCHER ARMAMENT PROCEDURE. Immediately before takeoff of aircraft, take the following steps:

1. Perform stray voltage check at HVAR receptacle in accordance with existing instructions.

2. Drop the Aero 14 and 15 striker arm contact pins onto the forward contact post, or plug the jumper harness into the Aero 20A bomb rack or other heavy duty bomb rack plug-in station.

3. Remove the remaining shorting button from the unused electrical receptacle by pulling on the dust cap, figure 7–18.

WARNING

Inspect the launcher receptacle to make sure that the line holding the shorting button did not break, leaving the launcher still shorted.

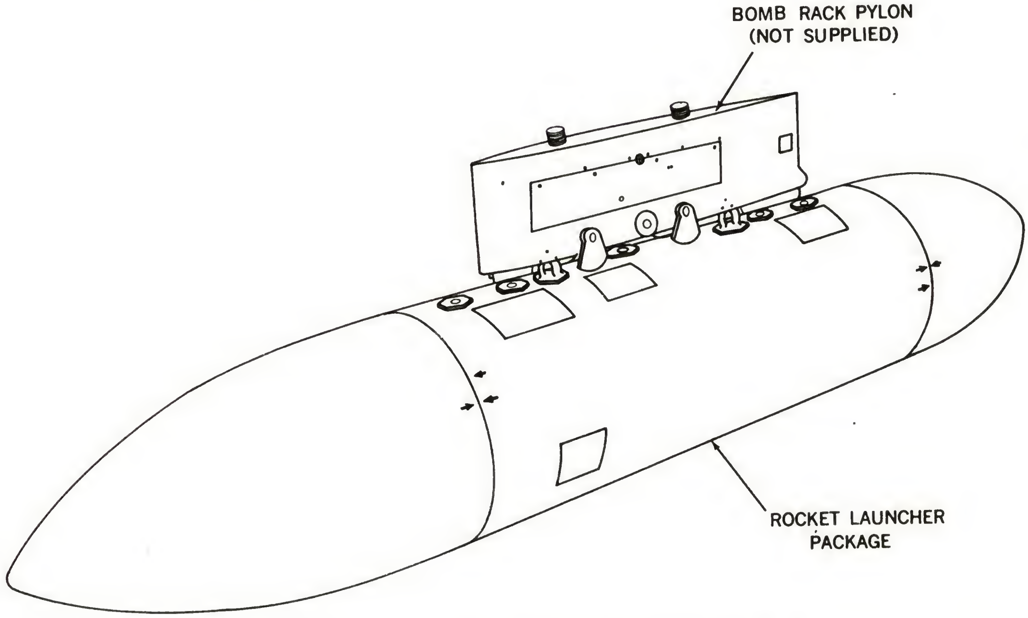


Figure 7–24. Launcher Installed on Aero 15 Bomb Rack.

4. Hold the shorting button up for pilot observation, if practicable, to indicate completion of the arming procedure.

5. Retain the shorting button for re-use should the pilot fail to fire the launcher package.

CAUTION: Never throw away the shorting button and dust cap where it is possible for it to be picked up by a jet aircraft intake. Severe engine damage may result.

PRECAUTIONS TO BE OBSERVED.

1. Handle the 2.75-inch FFAR per appropriate instructions for handling and use.

2. Make certain rocket warheads are securely attached before installing in launcher.

3. Check each rocket for detent locking before installing frangible fairings.

4. Check the ignition contact made between ground fingers (contact points) and rocket fin retainer contact button.

5. Check frangible fairings for proper latching. NEVER lift launcher by fairing.

6. NEVER connect a launcher to the aircraft without first making stray voltage check.

7. Remove shorting button just before takeoff of aircraft.

8. NEVER suspend launcher from bomb racks not having independent rocket firing and bomb circuits.

LAUNCHER DISARMING PROCEDURE. Immediately after an aircraft lands with a full or partially fired Aero 7D, commence disarming procedure in the following manner:

1. Replace the shorting button and dust cap cover on the appropriate electrical receptacle.

2. Disconnect the package from the aircraft by removing the jumper harness from Aero 20A and other heavy duty bomb racks.

3. Raise the striker pin on Aero 15 bomb racks.

WARNING

It will not be possible to raise the striker pin on Aero 14 bomb racks. The package must, therefore, be rendered safe by replacing the shorting button and dust cap, or by removing the intervalometer from the after bulkhead.

LAUNCHER UNLOADING PROCEDURE. Should it be necessary to unload a full or partially fired package, proceed in accordance with one of the following:

1. Remove fairings by reversing procedure outlined. Do not raise the fairing spring catch more than one-half inch, as excess bending will cause a permanent set in the spring, rendering it useless.

2. Grab the nose fuse wrenching flat with a U-shaped tool, and rotate clockwise while pulling at the same time. The motor fin assembly will raise the detent, releasing the rocket from the tube.

3. If this method fails, insert a long screwdriver or other suitable probe into the rear of the launcher tube, placing the tool under the detent extension arm. Lift the detent away from the rocket and push against the rocket contact button at the same time. The rocket will slip free of the detent.

4. Return unfired rockets to the magazine for disposition in accordance with current directives.

DISPOSITION OF LAUNCHER UNDER VARYING CONDITIONS. Disposition of fired, partially fired, and unfired launchers shall be made in the following manner:

1. During shipboard operation, it is recommended that all fired and partially fired launchers be jettisoned from the aircraft before landing aboard ship.

2. Unfired launchers, where no attempt was made to fire the launcher, should be returned aboard ship. Such launchers may be left on the aircraft, or returned to the magazine or storing area by reverse handling procedures.

3. Unfired launchers, where an attempt was made to fire, should be treated as

outlined. Investigation should be made to determine if the armament procedure was accomplished correctly. If so, inspect the intervalometer in accordance with the procedure described. Packages so inspected and falling short of the category described shall be reported by RUDUM to BuAer. Then dispose of the launchers.

Disposition of Launcher Shipping Protectors and Extra Suspension Lugs. Dependent upon the nature of shipboard operation, disposition of the launcher shipping protectors and extra suspension lugs shall be accomplished in the following manner.

1. During any emergency or combat operation all excess shipping gear may be jettisoned.

2. During noncombat operations where return logistics are adequate and economical, retain shock pans, locking rings, covers, and spare suspension lugs for palletizing and return shipment to the ammunition loading depot.

Preparation for Reshipment. To pack launcher for reshipment, reverse the procedure described.

Operation Instructions.

Principles of Operation. In operation, the ignited rockets overcome the detent by blasting against the inclined plane of the detents and releasing the rockets. This does not restrain the forward motion of the rocket. The firing impulse is distributed to the rockets by a shunt-fuse intervalometer which is "lugged in" to the launcher after bulkhead. The wiring of the intervalometer converts the aircraft firing pulse into ripple-firing with a 10-millisecond delay interval. The frangible fairings shatter readily from rocket impact and backblast.

Operation. Operation of the Aero 7D Rocket Launcher Package is accomplished through the standard armament system in the aircraft. The pulse is dispersed to the rockets in pairs except the last one, which is a single-fire. A separate electrical impulse to the bomb rack release solenoid is required to jettison the launcher after firing, or in case of an emergency.

1. The launcher intervalometer requires a minimum firing pulse of approximately 150 milliseconds; therefore, failure to fire all rockets usually indicates that the aircraft stepper switch does not rest on the bomb rack firing circuit station long enough to energize all nineteen rockets. On AD type aircraft, firing pulse time is computed as one-half the cockpit accelerated stepper-rate intervalometer time. Therefore, it is recommended that no attempt be made to fire packages at a rate greater than three releases per second.

2. If a tactical mission requires that a firing rate greater than three releases per second is necessary, it is probable that a few rockets will remain. Another firing attempt then should be made to expend the remaining rockets.

3. Should a package fail to fire all rockets after repeated attempts, inspect the intervalometer after landing, and after disarming and unloading procedures have been accomplished. Visual inspection of the intervalometer will probably reveal a burned-out high-resistance shunt wire above the numbers located on the base of the intervalometer, indicating an interval short in the launcher package. However, a burned-out shunt wire link between number 10 and the ground bus bar is normal. This condition occurs when all rockets have fired and the aircraft current stays on long enough to burn out the link.

4. Failure to fire all rockets as described in step 1 and step 3 will show that all the contact fingers did not drop.

Changing Rocket Warheads. Should it become necessary to change rocket warheads, remove rockets from launcher as outlined and proceed in accordance with OP 1793, "2.75-Inch Folding-Fin Aircraft Rocket, Description and Instructions for Use."

Maintenance Instructions. The Aero 7D Rocket Launcher Package is expendable and

no adjustments or maintenance are required. Replacement of the intervalometer is possible, if necessary.

Testing Procedure. There are no testing procedures required on the Aero 7D Rocket Launcher Package other than those specified.

Chapter 8

CIRCUIT CONTINUITY TESTERS, ARMY-TYPE TRIPLET MODELS, 680A AND 680B

General

CAUTION: A rocket circuit continuity tester should not be issued or used aboard ship without specific permission from the Bureau of Naval Weapons.

Circuit Continuity Testers 680A and 680B are issued to ammunition depots for testing the electric circuit in rocket motors. When the circuit is found to have a resistance too high or too low, the motor should not be issued to the Fleet.

The complete electric circuit is tested, including the terminal lead wires, wire connectors, igniter lead wires, bridge of the igniter squib, and the junctions of these elements.

Use of the testers for testing motors located far from the tester, such as in an isolated cell, is not advisable because of the limited output of the battery used in the tester. It also would be necessary to recalibrate the scale to incorporate the resistance added by using leads longer than the test leads supplied with the testers.

At present, rocket motors are tested at ammunition depots by remote control. The test station may comprise an isolated cell and a remotely located operating panel. The tester, similar to the Circuit Continuity Testers 680A and 680B, and a safety switch are installed on the operating panel. Test cables are run to the cell. One end of each cable is connected to the safety switch. The other ends are connected to a receptacle in the cell. The electrical connector of the motor being tested is plugged into this receptacle. Motors are placed nozzle-end up on mobile racks so that an operator may test several motors at one cell loading.

There is no standard testing facility nor test procedure employed at the several ammunition depots. However, each test facility, test procedure, and operational safety program, must be authorized by the Bureau of Naval Weapons.

Description

Circuit Continuity Testers 680A, figure 8–1, and 680B, figure 8–2, are electric instruments based on a Wheatstone bridge circuit. Each test set consists of a meter, a switch, two external sockets, a means for connecting either rocket motor electrical connector plug or test leads, a 1½-volt dry cell battery, and two test leads. It is so designed that the current flowing through the rocket motor igniter circuit under test cannot exceed 5 milliamperes.

The meter on the instrument has a double scale and indicates resistance in ohms. The lower scale, marked "HVAR," is to be used only with motors for 5-Inch High-velocity Aircraft Rockets and 11.75-Inch Aircraft Rockets. The motors of these two rocket types contain an igniter with two squibs wired in parallel. The upper scale indicates the resistance of the circuit in motors containing single-squib igniters. An adjusting screw, located below the meter dial, is used for zeroing the pointer of the meter.

The Circuit Continuity Tester 680B was developed to receive the Army-type electrical connector plug and to provide a smaller, more accurate unit than the 680A. The 680B has a receptacle for the Army-type plug on the top surface of the tester; it has no receptacle for the Navy-type plug.

Two test leads are issued with the instrument for use on rockets without electrical connector plugs. Each test lead assembly consists of two prods, joined by means of long leads to an Army plug or jack plug. The prods are maintained a fixed distance apart by a distance member.

Preparing Test Set for Use

Zeroing the Pointer. The procedure for zeroing the meter pointer is as follows.

1. Turn the switch off.
2. Turn the adjusting screw slowly and carefully until the pointer rests directly over the index mark centered over OK on the dial.

Checking the Dry Cell. The procedure for checking the dry cell of the tester is as follows:

1. Turn the switch to BATT CHECK and note the reading on the dial.

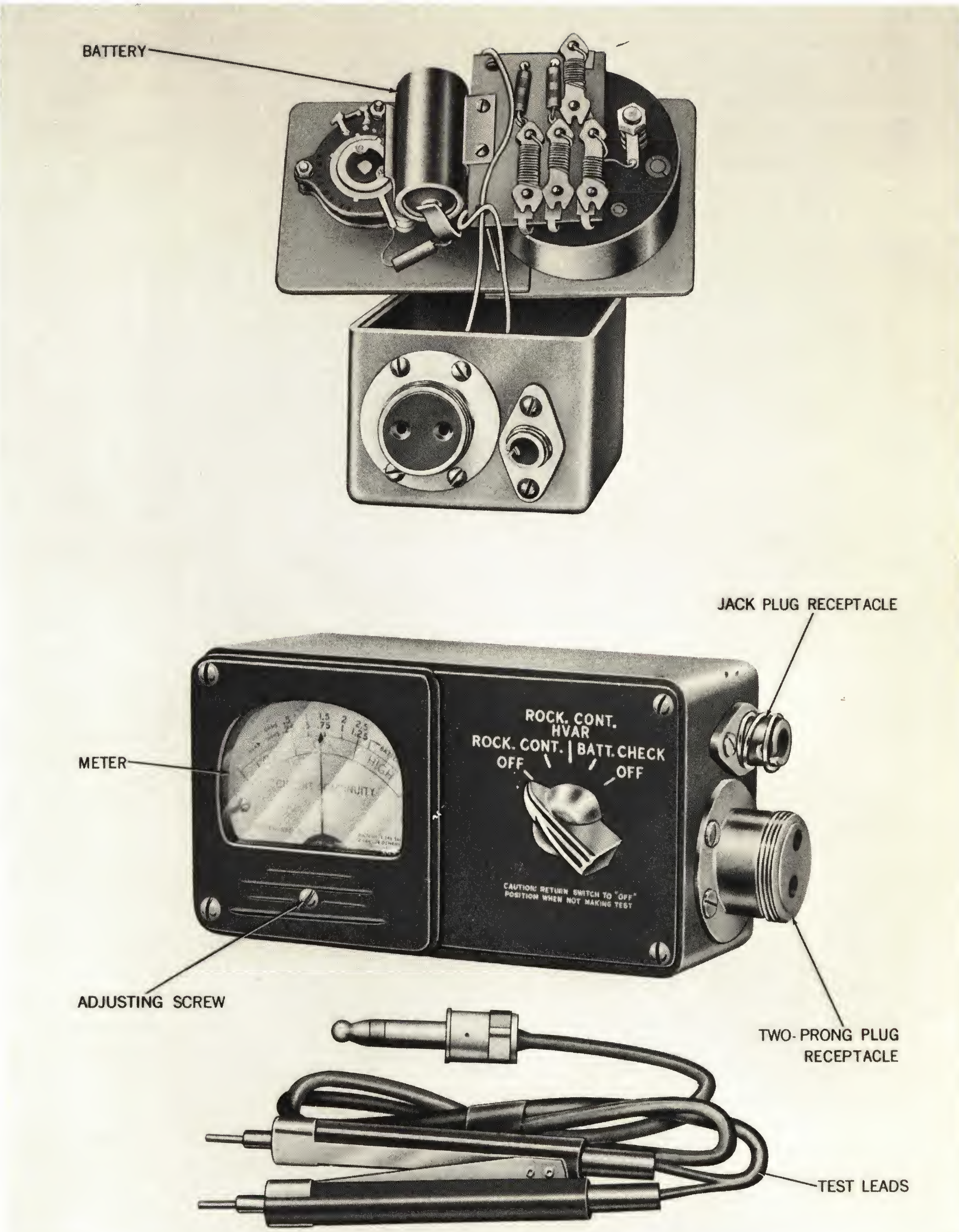


Figure 8–1. Circuit Continuity Tester Model 680A, Disassembled, External View, and Test Leads.

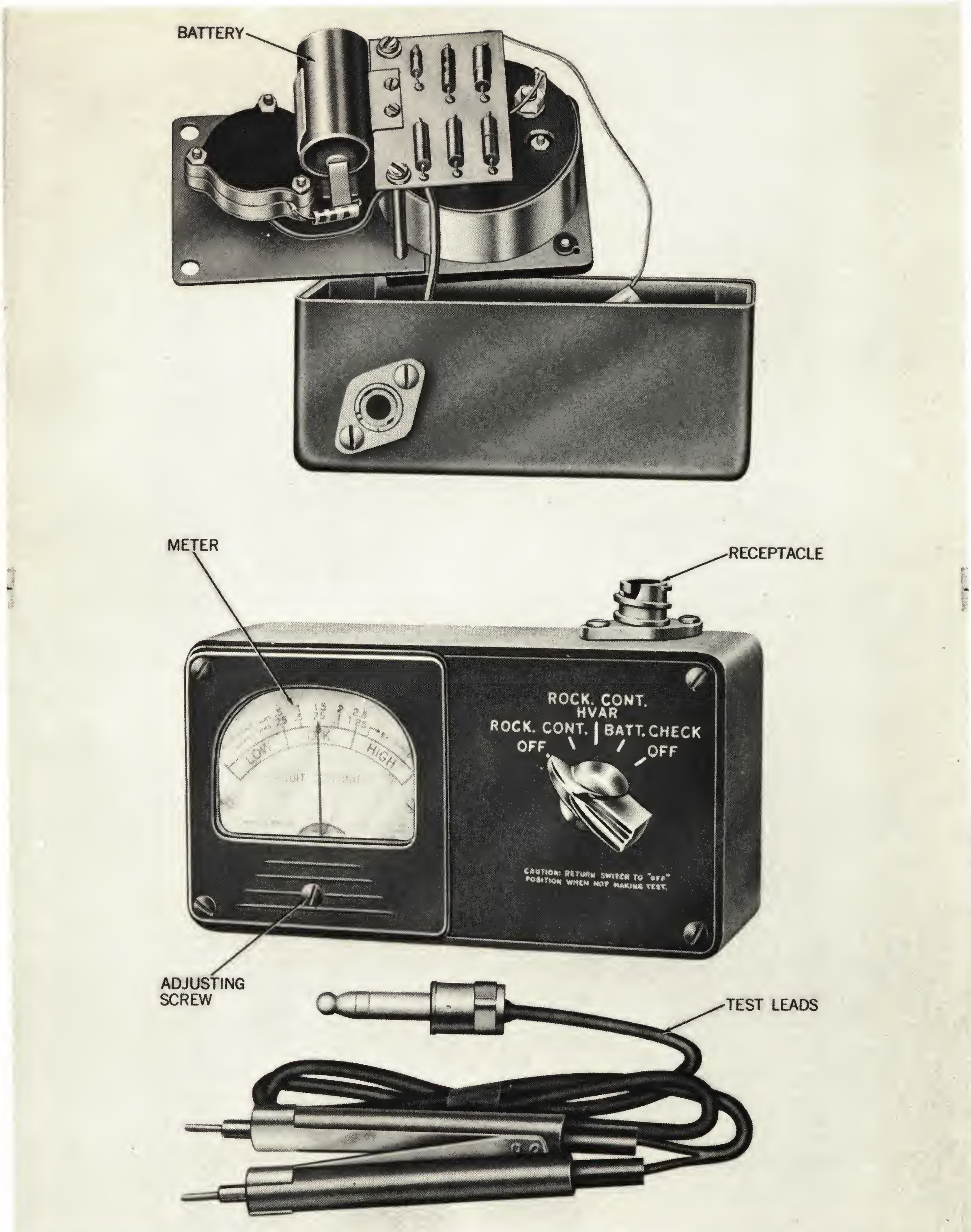


Figure 8–2. Circuit Continuity Tester Model 680B, Disassembled, External View, and Test Leads.

2. Turn the switch to OFF. A good dry cell is indicated by a pointer deflection to the right of the line marked BATTERY OK. A low dry cell (15 percent below normal) is indicated by a pointer deflection to the left of the line marked BATTERY OK.

Replacing the Dry Cell. Figures 8–1 and 8-2 show the location of the dry cell battery in Models 680A and 680B. The procedure for replacing a bad dry cell is as follows:

1. Unscrew the four screws in the corners of the tester and lift off the face of the instrument.

2. Replace the dry cell with Dry Battery BA–42 or an authorized equivalent. Make sure that the center terminal of the dry cell is toward the long battery-holder member marked with a red dot.

3. Replace the face of the tester and repeat the dry cell check. If the dry cell tests OK, the igniter circuit test may then be performed.

CAUTION: Dry cells should be changed by authorized personnel only. Any damage to the test set might cause abnormal currents to be delivered to the igniter circuit.

Test Procedures

Rocket motors shall be tested for continuity only in a Bureau-of-Naval-Weapons-approved building which provides a suitable barricaded or isolated cell. A minimum of personnel shall be present when motor circuits are being tested.

Rocket-motor igniter circuits shall be tested only while the motor is in the nonpropulsive state; that is, before assembly of motors and warheads. All personnel should stay clear of the ends of the motor in case of accidental ignition.

The general procedure for testing motors that have electric plugs is as follows.

1. Check the test set battery.

2. See that the safety switch in the test cable circuit is open.

3. Remove the shorting clip and insert the plug of the electrical connector on the motor being tested into the test cable receptacle inside the test cell or barricaded area.

4. Clear personnel from the vicinity of the test cell or barricade.

5. Turn the switch on the circuit continuity tester to the type of rocket being tested—HVAR, for motors with double-squib igniters; or ROCK CONT, for motors with single-squib igniters. Remember to read the scale which corresponds to the switch setting.

6. Close the safety switch and note the movement of the pointer on the meter.

7. If the pointer rests within the space marked OK, the motor is satisfactory. Reject the motor if the pointer rests within the LOW or HIGH regions of the scale.

8. Open the safety switch.

9. Remove the plug of the electrical connector on the motor being tested from the receptacle in the test cell or barricade.

10. Replace the shorting clip on the plug of the electrical connector.

Precautions for Handling Circuit Continuity Testers

1. Keep the tester switch in the OFF position at all times when the instrument is not in use. Failure to do so will cause the battery to run down.

2. Equipment containing batteries or other sources of electricity must never be tested with this circuit continuity tester. The meter or Wheatstone bridge circuit can be burned out.

3. When the instrument is returned to its carrying case, the meter end should always be toward the bottom of the case.

4. Keep the test set and carrying case dry.

Appendix A

OBSOLESCENT COMPONENTS AND ASSEMBLIES

General

Obsolescent rounds are treated in this section. These rounds are still capable of use but they have been replaced by improved designs. Also included are items with a tactical purpose which is no longer important.

See OP 1515 "Restricted and Unserviceable Ammunition" for assemblies and components which have been declared obsolete.

3.0-INCH ROCKET MK 15 MODS 0 AND 1 (AIRCRAFT, NIGHT DRIFT SIGNAL, RETRO-300 FPS)

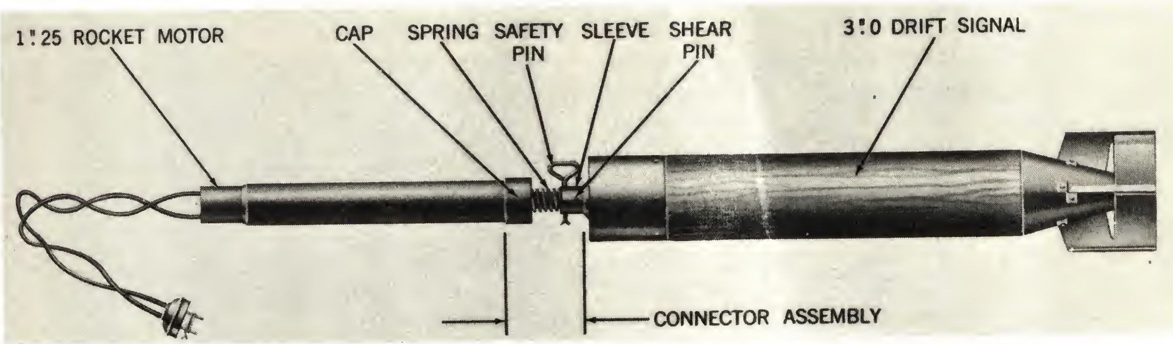


Figure A–1. 3.0-Inch Rocket Mk 15 Mod 1 (Aircraft, Night Drift Signal, RETRO–300fps).

Mark	15
Mod (Mods differ only in the electrical connector.)	0 and 1
General Arrangement	375030
List of Drawings	108811
Nominal Weight (lb)	4.80
Overall Length (in.)	32.46
Night Drift Signal, AN-Mk-Mod	5–4
General Arrangement	982534
List of Drawings	256089
Weight (lb) (approx)	3
Delay (sec.)	8 to 12
Burning Time (min) (approx)	12
Smoke Color	White
Motor, 1.25-Inch, Mk-Mod (Mods differ only in the electrical connector.)	2–0 and 1
Loading Assembly No.	375026
List of Drawings	108664
Lot No. Prefix:	
Mod 0	RMAB
Mod 1	RMAE
Nominal Weight Shipped (lb)	1.80
Nominal Weight Fired (lb)	1.80
Thrust (lb)	270
Overall Shipping Length (in.)	13.47
Length without Details (in.)	13.47
Burning Time (sec.)	0.16
Propellent Grain Mk-Mod	4–1
Igniter Mk-Mod	105–0 or 1
Electrical Connector Type:	
Mod 0	Household
Mod 1	Army-Navy
Container Mk-Mod	2–0 or 1

Special Information

This rocket-powered pyrotechnic signal is retro-fired at 300 fps from patrol aircraft to mark a target. Firing of the rocket initiates the delay firing mechanism of the drift signal.

After the rocket motor propellant burns out, the motor is jettisoned from the signal by action of a spring and the signal falls into the sea. The delay firing mechanism activates the signal.

1.25-Inch Rocket Motor Mk 2 All Mods has a single nozzle and a cylindrical, radially perforated propellent grain. A dessicant bag is assembled in the nozzle and secured by the nozzle seal. The Mod 1 differs from the Mod 0 since the Mod 1 has an Army-Navy-type, two-prong electrical connector plug while the Mod 0 has a standard household-type, two-prong electrical connector plug.

The connector assembly of the rocket motor joins the motor to the drift signal, initiates the drift signal, and jettisons the motor when the rocket propellant has burned out. The connector assembly consists of a cap, sleeve, spring, shear pin, and safety pin, figure A–1. The cap has female threads at one end which mate with male threads in the rocket motor tube. At the other end of the cap, a shaft is held in the sleeve by the safety and shear pins. The sleeve has male threads which secure it to the drift signal.

When the safety pin has been removed and the rocket fired, the shaft in the connector assembly is driven toward the signal, breaking the shear pin. This compresses the connector's spring; it also overcomes the spring under the firing pin in the signal. The firing pin is driven into the primer of the signal, initiating the delay fuse.

After the propellant burns out in the rocket motor, ending its thrust against the signal, the compressed spring of the connector pushes the cap out of the sleeve. This separates the rocket motor from the signal.

Night Drift Signal AN-Mk 5 Mod 4 produces light and smoke. The signal consists of a die-cast nose, wood body, and sheet metal tail. The nose contains a spring-held firing pin and a primer. The body is a wood cylinder with a hole in the center, in which are three pyrotechnic pellets in a moisture-proof tube.

A delay fuse connects the primer, through a hole in the center of the pyrotechnic pellets, to the firstfire quickmatch at the tail end of the signal. A capped hole leads from the pyrotechnic pellets to the tail end.

When the rocket is fired, the cap of the connector assembly is driven against the firing pin. The firing pin initiates the primer which, in turn, initiates the delay fuse. The delay fuse burns for 8 to 12 seconds before it ignites the firstfire quickmatch.

Burning of the quickmatch ignites the pyrotechnic pellets. The increase in pressure inside the signal blows the cap from the tail opening, allowing the flame and smoke to flow from the signal. It floats tail-end up.

In assembling the rocket, proceed as follows:

1. Screw the motor tube into the female threads of the connector assembly cap.
2. Unscrew the retaining nut from the nose of the drift signal and remove the sealing disc. Do not touch the firing pin.
3. Screw the assembled rocket motor and connector into the head of the drift signal. Do not remove the safety pin or shear pin of the connector.

In disassembling this rocket, proceed as follows.

1. See that the short-circuiting wire is in place on the plug of the electrical connector.
2. Be sure that the safety pin and shear pin are in place on the connector assembly.
3. Unscrew the connector sleeve from the head of the drift signal.
4. Replace the sealing disc in the cavity of the signal.
5. Replace the retaining nut on the nose of the signal and return the signal to its container.
6. Unscrew the cap of the connector assembly from the nose of the rocket motor.
7. Return the rocket motor and connector assembly to their container.

3.0-INCH ROCKET MK 16 MODS 0 AND 1 (AIRCRAFT, NIGHT DRIFT SIGNAL, RETRO-200 FPS)

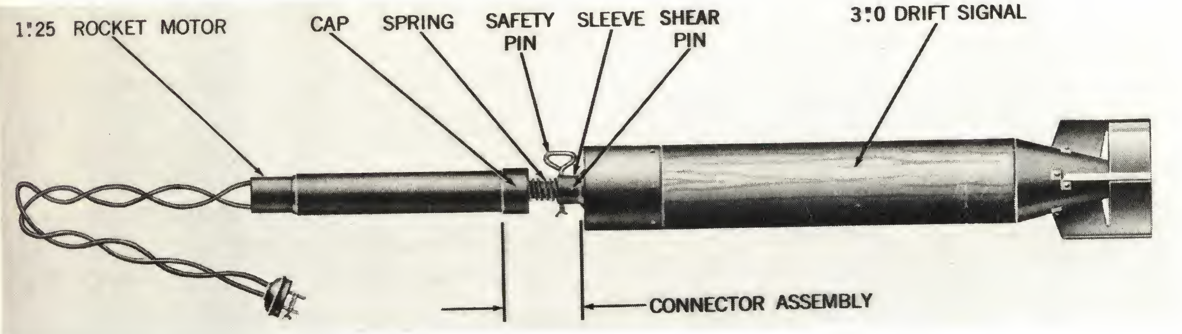


Figure A–2. 3.0-Inch Rocket Mk 16 Mod 1 (Aircraft, Night Drift Signal, RETRO—200 fps).

Mark	16
Mod (Mods differ only in the electrical connector.)	0 and 1
General Arrangement	389040
List of Drawings	108812
Nominal Weight (lb)	4.55
Overall Length (in.)	30.45
Night Drift Signal, AN-Mk-Mod	5–4
General Arrangement	982534
List of Drawings	256089
Weight (lb) (approx)	3
Delay (sec.)	8 to 12
Burning Time (min) (approx)	12
Smoke Color	White
Motor, 1.25-Inch, Mk-Mod (Mods differ only in the electrical connector.)	3–0 and 1
Loading Assembly No.	388832
List of Drawings	108665
Lot No. Prefix:	
Mod 0	RMAC
Mod 1	RMAG
Nominal Weight Shipped (lb)	1.55
Nominal Weight Fired (lb)	1.55
Thrust (lb)	200
Overall Shipping Length (in.)	11.34
Length without Details (in.)	11.34
Burning Time (sec.)	0.15
Propellent Grain Mk-Mod	5–1
Igniter Mk-Mod	105–0
Electrical Connector Type:	
Mod 0	Household
Mod 1	Army-Navy
Container Mk-Mod	3–0 or 1

Special Information

This rocket-powered pyrotechnic signal is retro-fired at 200 fps from patrol aircraft to mark a target. Firing of the rocket initiates the delay firing mechanism of the drift signal.

After the rocket motor propellant burns out, the motor is jettisoned from the signal by action of a spring and the signal falls into the sea. The delay firing mechanism activates the signal.

1.25-Inch Rocket Motor Mk 3 All Mods has a single nozzle and a cylindrical, radially perforated, propellent grain. A dessicant bag is assembled in the nozzle and secured by the nozzle seal. The Mod 1 differs from the Mod 0 since the Mod 1 has an Army-Navy-type, two-prong electrical connector plug while the Mod 0 has a standard household-type, two-prong electrical connector plug.

The connector assembly of the rocket motor joins the motor to the drift signal, initiates the drift signal, and jettisons the motor when the rocket propellant has burned

out. The connector assembly consists of a cap, sleeve, spring, shear pin, and safety pin, figure A–2. The cap has female threads at one end which mate with male threads in the rocket motor tube. At the other end, a shaft is held in the sleeve by the safety and shear pins. The sleeve has male threads which secure it to the drift signal.

When the safety pin has been removed and the rocket fired, the shaft in the connector assembly is driven toward the signal, breaking the shear pin. This compresses the connector's spring; it also overcomes the spring under the firing pin in the signal. The firing pin is driven into the primer of the signal, initiating the delay fuse.

After the propellant burns out in the rocket motor, ending its thrust against the signal, the compressed spring of the connector pushes the cap out of the sleeve. This separates the rocket motor from the signal.

Night Drift Signal AN-Mk 5 Mod 4 produces light and smoke. The signal consists of a die cast nose, wood body, and sheet metal tail. The nose contains a spring-held firing pin and a primer. The body is a wood cylinder with a hole in the center, in which are three pyrotechnic pellets in a moistureproof tube.

A delay fuse connects the primer, through a hole in the center of the pyrotechnic pellets, to the firstfire quickmatch at the tail end of the signal. A capped hole leads from the pyrotechnic pellets to the tail end.

When the rocket is fired, the cap of the connector assembly is driven against the firing pin. The firing pin initiates the primer which, in turn, initiates the delay fuse. The delay fuse burns for 8 to 12 seconds before it ignites the firstfire quickmatch.

Burning of the quickmatch ignites the pyrotechnic pellets. The increase in pressure inside the signal blows the cap from the tail opening, allowing the flame and smoke to flow from the signal. The signal floats tail-end up.

In assembling this rocket, proceed as follows:

1. Screw the motor tube into the female threads of the connector assembly top.
2. Unscrew the retaining nut from the nose of the drift signal and remove the sealing disc. Do not touch the firing pin.
3. Screw the assembled rocket motor and connector into the head of the drift signal. Do not remove the safety pin or shear pin of the connector.

In disassembling this rocket, proceed as follows:

1. See that the short-circuiting wire is in place on the plug of the electrical connector.
2. Be sure that the safety pin and shear pin are in place on the connector assembly.
3. Unscrew the connector sleeve from the head of the drift signal.
4. Replace the sealing disc in the cavity of the signal.
5. Replace the retaining nut on the nose of the signal and return the signal to its container.
6. Unscrew the cap of the connector assembly from the nose of the rocket motor.
7. Return the rocket motor and connector assembly to their container.

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